A REPORT ON

THE SUMMER INSTITUTE FOR BIOMEDICAL RESEARCH IN TECHNOLOGY UTILIZATION

JUNE 23 - AUGUST 29, 1969

PREPARED FOR:

TECHNOLOGY UTILIZATION DIVISION (CODE UT)

OFFICE OF TECHNOLOGY UTILIZATION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

BIOLOGICAL SCIENCES COMMUNICATION PROJECT
THE GEORGE WASHINGTON UNIVERSITY MEDICAL CENTER
2000 P STREET, N.W., WASHINGTON, D. C. 20036
Tel. 202—462-5828

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BY:

MR. JOHN JOHNSTON

BIOLOGICAL SCIENCES COMMUNICATION PROJECT

MEDICAL CENTER

THE GEORGE WASHINGTON UNIVERSITY

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I. INTRODUCTION

The purpose of this report is to provide a brief history of the Institute for Biomedical Research in Technology Utilization held at the Goddard Space Flight Center, June 23 through August 29, 1969. This report is primarily a chronicle of the planning, development, and management of the Summer Institute. Its second goal is to provide some of the input necessary to evaluate the Summer Institute in terms of meeting the Summer Institute's objectives, NASA/TUD's objectives, and general educational goals. It is hoped that this report will be of value to other NASA Technology Utilization Officers in planning and conducting similar programs.

II. HISTORY

A. Background and Preliminary Plans

Early in December of 1968, Mr. Kenneth F. Jacobs, the Technology Utilization Officer of NASA's Goddard Space Flight Center (GSFC) discussed with his supervisor, Mr. Charles Boyle, Director of Special Projects of GSFC, the possibility of initiating a special project out of the Technology Utilization Office.

Shortly after this general discussion, the NASA Headquarters Technology Utilization Division's Functional Review of the GSFC Technology Utilization Office was carried out, at which time, Mssrs. Philips and Ault of TUD asked for information pertaining to special projects which the GSFC TUO anticipated to further the TU mission there. It was on this occasion that the concept of the Summer Institute was first presented.

The concept, at that time, was to establish teams of engineering undergraduate students who would be assigned to various technical divisions of GSFC for the purpose of seeking out new technology being developed in those laboratories, evaluating it, and processing it through the TUD system for possible publication.

During the first quarter of 1969, it was learned that there was a possibility of obtaining funds for use by the TU office at GSFC to support a special prject of the type discussed during the review. A proposal to conduct this Summer Institute in Technology Utilization was prepared and submitted to the GSFC management. A facsimile of that proposal may be found in Appendix II.A.1. The GSFC management felt that the concept of a Summer Institute to present the concepts of technology utilization to the students was basically sound, but also felt that the students should be involved in tasks other than seeking out new technology, thus the initial proposal was rejected.

Early in April, it was decided to change the theme of the proposed institute to that of biomedical research and a new proposal for a Summer Institute for Biomedical Research in Technology Utilization was prepared by Mr. Jacobs and submitted to GSFC management. Center

management agreed to allow such an effort to be conducted at GSFC utilizing their facilities and personnel. A facsimile of this final proposal may be found in Appendix II.A.2.

Following this acceptance, informal preliminary discussions with personnel of the George Washington University School of Engineering and Applied Science were begun and plans for the Summer Institute were formulated.

Based on the need for expediency, it was determined that funding would best be handled by addition of the project to an existing contractual arrangement, rather than by establishing a separate contract for the Summer Institute. The Biological Sciences Communication Project of the George Washington University Medical Center was under contract to the Technology Utilization Division to design, coordinate, and analyze systems to accelerate the flow of NASA Technology to the needs of biomedical research. The BSCP contract, due to expire, was then being processed for renewal. Toward the middle of April, the BSCP was asked to include the Summer Institute project in their upcoming contract as an addition to the new work statement and to provide administrative support to the project. The BSCP agreed to this request.

There were subsequent meetings between personnel of GSFC and Headquarters TUD personnel to settle major problem areas. Simultaneous meetings were also held with representatives of the GWU Engineering School and BSCP to assure their interest in such a venture and to lay the groundwork for action.

B. Objectives

The stated objectives for conducting this Summer Institute for Biomedical Research in Technology Utilization were as follows:

1. To provide an opportunity for students to engage in research for the purpose of solving selected technical problems in the biomedical field.

2. To foster interest in the field of medical engineering to bridge the ever-widening gap between the engineering and medical professions.

3. To provide students with an awareness of the career opportunities available in scientific and engineering work in NASA.

4. To generate a medium by which the existence and purpose of the NASA Technology Utilization Program can be communicated to a number of engineering colleges.

5. To provide students with an appreciation for the variety and sophistication of technology developed by NASA scientists and engineers.

6. To evaluate the potential of the Summer Program in achieving the above objectives so that consideration can be given to adoption of similar Summer Institutes at other NASA Centers.

While unstated, it was felt by some of the planners an important objective of this Summer Institute was to test the validity of such a mechanism in accelerating the flow of NASA technology through center expertise, facilities, and equipment, toward solutions to major public sector problems, in this case problems in medical application of engineering knowledge and developments.

C. Program Development

Following preliminary planning and development of program objectives, the next step was the establishment of roles for the participating groups and personnel, of mechanisms for action by the groups, and delineation of specific responsibilities of the participants.

1. Roles of the Participating Groups: The following is a brief outline of the general roles of the four participating groups:

a. NASA Headquarters Technology Utilization Division (NASA/TUD): This group under direction of Mr. Ronald J. Philips was to provide funding for the Summer Institute. Mr. Philips was to be concerned with providing overall program direction. Mr. James T. Richards, Jr. of TUD, who is responsible for operation of the Biomedical Applications Program, also was to provide assistance at the managerial level.

b. Goddard Space Flight Center Technology Utilization Office (GSFC/TUO): As indicated previously, Mr. Kenneth F. Jacobs, the Technology Utilization Officer at Goddard was the prime mover in planning and developing this program of a Summer Institute for Biomedical Research in Technology Utilization. In addition to his planning and developing roles, Mr. Jacobs was to coordinate day-to-day operations while the students were at GSFC.

c. George Washington University Department of Electrical Engineering (GWU/EE): Dr. Marvin F. Eisenberg of this department, with the assistance of Dr. Richard Fowler of the GWU Hospital, was to be responsible for the conduct of the "academic" portion of the Institute, including selection of course, text, students, and instructors, as well as the actual conduct of the class. In so far as the research to be conducted by the students was related to current research of Drs. Eisenberg and Fowler, they were also to be responsible for technical direction of the students in performance of the research projects. Also, as set forth in the final proposal (Appendix II A 2), Dr. Eisenberg was to prepare a final report assessing the results of the Summer Institute, due within 60 days of the end of the Institute.

d. George Washington University Biological Sciences Communication Project (GWU/BSCP): Dr. Charles W. Shilling, Director of the BSCP, was to be responsible for overall coordination of the Summer Institute, specifically coordination of efforts between the participating groups. As the contractor for the Institute, the BSCP was also to be responsible for all fiscal activity associated with the Institute, and for preparation of a final report. Mr. John W. Johnston of the BSCP was to have the responsibility of assisting Mr. Jacobs with Institute planning and development, and assisting with coordination efforts, and in preparation of the final report.

2. Mechanisms for Action: Because of the experimental nature of this program and because of the shortage of time available, it was decided that use of PERT or other such management control techniques would not be feasible.

Rather, development of the program mechanics was based on use of frequent informal sessions between representatives of participating groups for delineation of responsibilities, establishment of priorities, and reports of progress. Sessions between these personnel were held as frequently as twice per week with telephone conversations almost daily during the months of April, May, and June. All decisions, important comments, etc., were prepared in the form of memoranda and distributed to the groups. At regular intervals, "Action Item Lists", based on results of the previous sessions, were published and distributed to the groups. A facsimile of one such "Action Item List" may be found in Appendix II C 1.

This type of operation required considerable coordination of effort and close communication between participating personnel. However, it was considered optimum under the circumstances and proved to be highly successful.

3. Delineation of Responsibility: The following is a brief and somewhat chronological outline of delineation of responsibility established for this program, broken down according to phase of program:

a. The Proposal

GSFC/TUO: Provide GWU/BSCP with descriptive paragraphs for incorporation in proposal. See Appendix II C 2.

GWU/EE: Provide detailed cost data to GWU/BSCP for conduct of lecture course and research effort.

GWU/BSCP: Prepare and submit proposal to conduct Summer Institute, as an additional task order of current contract.

NASA/TUD: Provide assistance in expediting proposal through to contract stage.

NOTE: A copy of the final proposal is in Appendix II C 3.

b. The Students

GWU/EE: Define type of student preferred; prepare and distribute announcement fliers; contact EE departments of local schools by telephone for suggested students; prepare and distribute student application forms; evaluate responses received; select students; notify students of selection/rejection; notify GWU/BSCP and others of selection.

GWU/BSCP: Prepare and distribute information packet to selected students; prepare and distribute questionnaires on transportation and lodging; receive and transmit completed questionnaires to GSFC/TUO; prepare biographical summary of each student and transmit to NASA/TUD; provide for long distance travel reimbursement and weekly stipend payment.

GSFC/TUO: Review questionnaires and arrange for student travel and lodging; arrange for welcoming of students to GSFC.

c. The Coursework

GWU/EE: Prepare course outline and develop lectures; select text and related materials; develop class orientation plan; arrange for lecture room in GWU Hospital; select and arrange for payment of guest lecturers; provide for student registration. Teach lecture course at GWU Hospital; prepare, administer, and grade final exam; give grades.

GSFC/TUO: Develop GSFC Orientation seminar plans; arrange for classroom space for final examination and seminars; present GSFC orientation seminar.

GWU/BSCP: Develop BSCP orientation seminar plans; present BSCP orientation seminar.

d. The Research

GWU/BSCP: Gather problems from Biomedical Applications Team Problem Abstracts; develop procedure for providing students with funds for requested supplies and equipment. Gather detailed information from Biomedical Applications Teams on each of the specific research projects.

GWU/EE: From Problem Abstracts and current research, establish problem areas and define research projects; select graduate student technical advisors. Divide students into five teams of two each and assign appropriate research projects. Provide technical assistance to student teams throughout Institute.

GSFC/TUO: On basis of defined research projects, arrange for use of appropriate GSFC laboratories; interview and select GSFC researchers to act as technical advisors to students; develop procedure for GSFC work orders to support student experimental needs. Arrange for and present seminars at GSFC to permit students to discuss progress of their research.

III. CONDUCT OF THE INSTITUTE

A. The Students

As indicated previously, it was the intent of the Institute planners to seek 10 senior engineering students, from out-of-state as well as local institutions, to participate in the Summer Institute. Selection was to be made on the basis of an academic accumulative average of 3.0 (out of a possible 4.0) or better, or upon specific endorsement of a faculty advisor. Further it was hoped to acquire students with both an exceptional problem-solving ability and an interest in medical technology.

A descriptive announcement (see Appendix III A 1) and several application forms (see Appendix III A 2) were sent to each of several universities. However, in the interest of saving time, it was decided that it would be necessary for the GWU Electrical Engineering Department Chairman to call his counterparts in the area Universities for recommended students. This was done and application forms transmitted.

A total of 11 applications were received throughout the month of May and the first week of June, and final student selection was completed in early June. Students were informed of their selection by letter from the Chairman of the GWU Electrical Engineering Department. A facsimile of that letter may be found in Appendix III A 3.

All students selected had completed their junior year of undergraduate study with the exception of Mr. Green. Through an oversight, Mr. Green, who had completed his freshman year at Auburn University and planned to transfer to Tuskegee, had been permitted to apply. The error was not discovered in time to be rectified. Except for Mr. Green, all students attended Universities in the Washington, D.C. area. A majority of the students, seven, had attended George Washington University and one student each had attended the University of Maryland, Howard University, and, of course, Auburn University. A brief biographical sketch for each student may be found in Appendices III A 4 - III A 13.

At the same time the students were notified of their selection for the institute, an informative letter, information folder, and questionnaire were sent to each of the students. A facsimile of the letter may be found in Appendix III A 14. The folder, an attractive Goddard Space Flight Center Folder, contained the following information:

NASA Publications: "SPACE: The New Frontier", EP-6, Rev. 1966
"Medical Benefits from Space Research"
"Introducing Goddard Space Flight Center"

MAPS: Location plan of Goddard Space Flight Center (Appendix III A 15)
Goddard/U. of Maryland map for housing, transportation (Appendix III A 16)

Schedule of Events of Summer Institute (Appendix III A 17)

Sample of aluminum/MYLAR "sandwich" used in ECHO II passive communications satellite.

A copy of the questionnaire is included as Appendix III A 18. This questionnaire was primarily for the purpose of establishing housing and transportation needs while attending the Institute. All questionnaires were returned to the BSCP within two weeks. Only two of the students, Mr. Azrael and Mr. Green, required dormitory housing and transportation from the dormitory to the Goddard Space Flight Center. This information was transmitted to Mr. Jacobs of Goddard who arranged housing with the University of Maryland. The cost of lodging was paid for by the students. Because of the proximity of the University of Maryland to Goddard, Mr. Jacobs arranged free transportation for Mr. Azrael and Mr. Green by Goddard employees. All other students lived in the area and commuted.

Mr. Green was the only student requiring funds for transportation to and from his home. A round-trip airline ticket was mailed to Mr. Green and he was reimbursed for taxi fare to and from the airports.

B. The Coursework

1. Preliminary Briefings

Upon arrival to the Goddard Space Flight Center on the first morning of the institute, and following the welcoming address by Dr. Michael J. Vaccaro, Assistant Director for Administration and Management, of Goddard, the students were presented the following briefings:

Preliminary Program Briefing
by: Mr. Kenneth F. Jacobs
Technology Utilization Officer
Goddard Space Flight Center

Technology Utilization - An Overview
by: Mr. Ronald J. Philips
Director, Technology Utilization Division
NASA Headquarters

NASA's Biomedical Applications Team Program
by: Dr. Quentin L. Hartwig
Director, Biomedical Applications Program
Biological Sciences Communication Project

How to Use NASA's Information Systems
by: Miss Adelaide Del Frate
Librarian
Goddard Space Flight Center

The following day was spent at the offices of the Biological Sciences Communication Project. The students heard presentations on the value of literature search before undertaking research, the problems involved in information research, and on the theory of transfer of information from developer to user.

2. The Course

The course taught at the Summer Institute was a three credit hour undergraduate/graduate course offered by the Department of Electrical Engineering of the School of Engineering and Applied Science of the George Washington University. The course was entitled EE181, Introduction to Medicine for Engineers. An Electrical Engineering Department description of the course indicates that it is designed to acquaint the engineering student with the physiology of the human body. The description further states that "The material presented is based on the curriculum of the medical school and is taught from a systems viewpoint. The concepts of cellular structure and function are integrated into the tissue and organs, which are then related to the various systems of the body. The interrelationships of the body systems are presented."

For the Summer Institute students, the lectures for this course were held for a period of five weeks on Tuesday and Thursday afternoons from 1:30 pm to 3:30 or 4:00 pm, with an hour and one-half available after the lecture for questions, discussions, etc. Breaks were provided. The lectures were co-chaired by Marvin F. Eisenberg, Ph.D. of the Electrical Engineering Department and R.C. Fowler, M.D. of the Medical Center. A specific subject was covered by lecture each class meeting by a guest lecturer and staff from the Medical Center followed by general discussion. The lecture schedule is Appendix III B 1.

Lectures were held in the George Washington University Hospital. It was thought that use of the hospital setting would be a dramatic means of accentuating the need for solutions to medical problems. Also, it was convenient for the guest lecturers to exhibit various equipment. Transportation was provided the students from Goddard to the hospital and return.

3. The Text

The text for this course was Best and Taylor's The Physiological Basis of Medical Practice, Eighth edition. This text is a medical school physiology text and is quite thorough and detailed. This text was chosen because of its detail and its potential as an important reference book for the students, should they continue in medical or biomedical engineering. In addition to the text, a pamphlet, put out by the American Medical Association and entitled, "The Wonderful Human Machine" was used. This pamphlet was provided to each student. In addition, many of the guest lecturers provided the students with a number of handouts on the particular lecture subject.

4. The Examination

As the appended schedule indicates, the last class meeting was devoted to review. On the class meeting day following that of the review, the final examination was given. The test was given to the students in classroom facilities at the Goddard Space Flight Center. A facsimile of the examination may be found in Appendix III.B.2. A two-hour time limit was put on the examination. All students completed the examination.

C. The Research

As duscussed previously, selection of the problems to be undertaken by the students during the Summer Institute was made after review of several Biomedical Applications Team Problem Abstracts, and was based on current research of Drs. Eisenberg and Fowler of the George Washington University Hospital. Following selection of the problems, pertinent Biomedical Applications Teams were requested by BSCP to provide related technical information gathered by the teams in the process of studying related but more specific problems, to provide assistance to the students. The information, which consisted of problem summaries, search strategies, abstracts, and pertinent references, was received early in the program and made available to the assistant instructors for copying and distribution to the students.

Two general problem areas were established. The potential solutions to these problems involved development of a physiological activity and environment monitoring system and development of an ultrasonic blood flow detection device. A brief description of each instrument follows:

Physiological Activity and Environment Monitor

This device was being developed to fill a need, considered vital according to Drs. Eisenberg and Fowler, for an easy to operate, unobtrusive, and relatively inexpensive system which would monitor and record, for up to 24 hours, various physiological and environmental parameters such as heart rate, footsteps, noise level, light level, temperature, etc. The design of this device provides for use by the patient in his home environment rather than under controlled conditions, such as in a clinic. The need for such devices has been indicated by the biomedical research community via problems accepted by Biomedical Applications Teams.

Previous development by Drs. Eisenberg and Fowler provided the following information on design of the Physiological Activity and Environment Monitor:

> The input to the basic system will consist of a series of pulses which represent the value of the parameter to be recorded. These impulses which originate in the input transducer will be fed into a very low power digital binary counter for a given time interval such as one minute. At the end of this time interval, the total number of stored pulses, giving a one minute average, will then be recorded on magnetic tape in a much shorter time such as two seconds. This will provide a tape expansion ration of 30 to one. Thus a one-hour tape cartridge could record up to 20 hours of data. Four tracks of data could be recorded simultaneously on a standard cartridge. In addition, by using multiplexing techniques, a number of parameters could be recorded on each track. The system, therefore, would have the capability of recording a considerable number of parameters for at least 24 hours. After recording, the tape would then be played and data displayed on a strip chart or other readout device. The complete system, therefore, would consist of the transducers with appropriate communication links, the digital and control electronics, the tape recorder, and the readout unit.

Ultrasonic Blood Flow Detection Device

This device was being developed to fill a need, again considered vital by Drs. Eisenberg and Fowler, that of a relatively compact inexpensive, and simple to use instrument for the detection of blood flow in patients with peripheral vascular disease. These patients generally have greatly decreased blood flow in the extremities resulting in a pulse so weak that it cannot be detected or only poorly detected by palpation. The results of previous work b y Drs. Eisenberg and Fowler at the George Washington University Hospital indicate that in many cases where pulse is not palpable, it can be detected using a CW ultrasonic doppler instrument. Additionally, the same instrument when further developed could be used for detection of heart and valve motion. The CW doppler ultrasonic system operates by transmitting a continuous signal into the body. A reflected signal is received from each interface which the signal encounters. If the reflecting surface is moving, such as the wall of an artery, there will be a shift in the frequency of the reflected signal. This shift in frequency will be proportional to the velocity of the moving sirface. This method tends to eliminate the effects of the stationary interfaces. This project required a thorough study, both theoretical and experimental, of the principles involved, an initial design including a breadboard model, a final design, construction of a complete unit and testing and evaluation of this unit.

Assignment of the Projects

As discussed previously, the students were divided into five teams of two each. The two research problems were then divided into five research projects, one for each team, as follows:

Physiological Activity and Environment Monitor

Project No. 1 - Transducers and Telemetry: The purpose of this project was to develop various simple to use and inexpensive transducers which will provide input to the digital counter. Two suggested transducers were for monitoring heart rate and footsteps, both measured in counts per minute. In addition, a low power telemetry system having a reliable range of approximately six feet, was to be developed to transmit these impulses to the central unit.

Project No. 2 - Electronics and Systems: The purpose of this project was to develop a very low power timing and control system, as well as modify an inexpensive commercial tape recorder. The unit should be packaged so as to make a compact, rugged usable system.

Project No. 3 - Readout system: The purpose of this project was to design and develop a complete readout system, the function of which would be to take the sequence of pulses representing each data entry on magnatic tape and convert the number of pulses to an anlog voltage. This voltage will than be recorded on paper using a conventional strip chart recorder.

Ultrasonic Blood Flow Detection Device

Project No. 4 - Ultrasonic Transducer and Artificial Artery: The purpose of this project was twofold. First a study of the principles involved in ultrasonic transducers, followed by design and development of an effective transducer. Second, design and construction of an "artificial artery" to be used in testing the ultrasonic motion detection device.

Project No. 5 - Electronics and Systems: The purpose of this project was to design and develop the electronics necessary to receive and amplify the reflected signal from the transducer and present the derived data for analysis.

At the first class meeting, the 10 students were divided into five teams and assigned the above research projects according to the following schedule:

Physiological Activity and Environment Monitor

Project No. 1 - Transducers and Telemetry:		Mr. Azrael Mr. Green
Project No. 2 - Electronics and Systems	:	Mr. Hatoum Mr. Ong
Project No. 3 - Readout System	:	Mr. Davies Mr. Armstrong

Ultrasonic Motion Detection Device

Project No. 4 - Transducer and Artificial Artery	:	Mr. Johnson Mr. Biosca
Project No. 5 - Electronics and Systems	:	Mr. Althouse Mr. Sirota

The selection of the team members and of the research project for each team were made on a volunteer basis after discussion of the various projects with the students. Following team and project selection, there was a general discussion on approaches, problems, and constraints associated with the various projects. For example, cost and size constraints were emphasized.

As described previously, a Goddard Space Flight Center engineer or scientist was selected to act as technical advisor for each team. Names of these technical advisors are presented on the Composite Information Sheet in Appendix III C 1.

In addition, two graduate students, Messrs. Olsen and Saunders, were utilized as assistant instructors, one for each of the broad problem areas. These personnel spent one-half of each working day at GSFC providing technical assistance to the students.

Conduct of Research

The students began their research effort in earnest on the second week of the institute. Arrangements were made for the students to have library privileges at the GSFC Library. The length of time taken in initial review of the literature was left up to the particular student, and varied from one to five or six days. However, most students made frequent trips to the Goddard Library throughout the course of the institute.

For the most part, the students followed the general pattern of research effort of general review, discussion of alternatives, development of plans and schematics, and then breadboarding and testing.

Sufficient information on size, cost, and performance constraints were available to the students so that their research efforts assumed the position of so-called adaptive engineering, i.e., taking available technology and adapting it to solution of a defined but unsolved problem.

Requests for tools, instruments supplies, etc. accessible through the GSFC were handled by work orders through Mr. Jacob's office. Requests for supplies and equipment for which funds were provided in the contract were processed by the administrative officer of the BSCP.

Progress by the students in their research was discussed in two seminars, one at the fifth week and one at the tenth week. These were seminars open to all GSFC scientists and engineers and other interested personnel, at which each team would present a discussion of their particular problem and report on progress toward solution. Attendees were encouraged to comment.

In addition, the students were required to maintain a laboratory project notebook. This notebook contained daily notations on progress of research through the course of the Institute. Electrostatic copies of the progress were submitted routinely to the course instructors for review.

The seminars and the project notebooks were considered valuable in the program for two reasons. First and most obvious, they provided a means of following the performance of the students. Second, they forced the student to realize the importance of accurately and lucidly recording and then presenting the results of his research. It was stressed to the student that this would be required of him when he began his own research.

IV. RESULTS

A. Program Performance

One measure of the performance of the Summer Institute lies in study of the comments of the participants. During the last week of the Institute, each student was asked to prepare a critique of the program. Facsimiles of these critiques may be found in Appendix IV A 1 - IV A 10. In addition, a questionnaire was sent by mail to each of the students with the last stipend payment, which asked them to respond to questions not completely answered in the critiques. A copy of this questionnaire may be found in Appendix IV A 11. Of the ten students, six responded to the questionnaire.

A statement of general comment on the Institute was prepared by Mr. Kenneth F. Jacobs of GSFC, as well as by four of the five GSFC technical advisors. Facsimiles of these statements may be found in Appendix IV A 12 - IV A 16.

The following is a synopsis of comments made on performance of the Summer Institute:

1. The Students - The general consensus of opinion of the personnel working with the students was that the students were well motivated, interested in the Institute, and as a whole, performed as well as or better than could be expected of them.

2. The Coursework

a. The Orientation - Most of the students were dissatisfied with the orientation period, thinking it too long, repetitious, and boring. Most agreed that one day devoted to facilities available to them at GSFC would have been satisfactory.

b. The Lectures - The comments of most of the students indicated that they felt the lectures were generally interesting, well presented, etc., but not applicable or "relevant" to the research projects. Some, however, considered the lectures uninspiring and boring. Dr. Eisenberg had indicated at the beginning of the Institute that the lectures would be general and not specifically related to the research projects. It should be noted that all but one of the six students responding to the questionnaire indicated that they would have participated in the Institute even if the course had not been for credit.

c. The Text - The students' comments of the medical physiology text were varied but, overall, they felt it was comprehensive and valuable as a reference, but a bit too advanced. The opinion on the pamphlet was unanimous: very good.

d. The Exam - The students rated the exam from fair to poor, the major complaint being that it did not represent the material covered in the lecture or the text. The NASA personnel that reviewed the exam considered it adequate. Such complaints by engineering students are quite common.

3. The Research Project

a. Assignment of the Projects - There was little comment on this. One student thought that "compatible" students should be matched up in teams. Some students felt that the goals of the project whould be more well defined early in the Institute and that there should have been more direction at the beginning. All seemed quite interested in their respective projects.

b. Laboratory Assignment - A few of the students felt that they had been assigned initially to laboratories in which sufficient facilities were not available to conduct their research and that this resulted in delays in starting their projects. The students were reassigned to adequate facilities.

c. Technical Advisor - The students were unanimous in their praise of the GSFC advisors and also felt the GWU/EE graduate student advisors were helpful, but felt they should have been full time advisors. The GSFC advisors all seemed enthusiastic about the program and recommended its continuation.

d. Literature Review - The students were split as to whether or not they spent sufficient time reviewing the literature prior to beginning their bench research. However, a number of students specifically commented that because of the short time available to them it would have been desirable to have had a good state-of-the-art literature waiting for them. No comments were made concerning the quality of the information provided by the Biomedical Applications Teams.

e. Facilities, Materials, Equipment - Again, the students were unanimous in their praise of the GSFC Facilities and testing equipment. The major complaint, heard from both students and advisors, was that money was not available for equipment. This was obviously a case of break-down of communication. Money was available, but specific items of equipment were not formally requested through the contract until the last two weeks of of the Institute. This equipment was made available within a few days of the requests.

f. Seminars and meetings - Most of the students and one of the advisors felt the seminars and meetings were unnecessary and took already limited time away from research. A number of suggestions for improvement of the seminars were presented in the critiques and questionnaires.

g. Contributions to Medical Research - In response to one question in the last questionnaire sent to the students, all of the six students responding felt that they had "...contributed to solution of a biomedical problem..."

4. The Program Management - The general consensus of opinion of the students was tham, for the first attempt at such a program, the management effort was quite satisfactory, especially that of the GSFC personnel. The complaints were confined to relatively minor points such as lateness of stipend checks, lack of communication between management, and local travel inconvenience.

B. Achievement of Objectives

Review of the various statements and comments of the participants of the Summer Institute for Biomedical Research in Technology Utilization would certainly indicate that both the student-related and the

stated (NASA) objectives of the Institute were achieved. Below is a synopsis of comments made pertaining to achievement of objectives.

1. To provide an opportunity for students to engage in research for the purpose of solving selected technical problems in the biomedical field - This objective was obviously met. In fact, nearly all the students responding to the questionnaire sent out with the last stipend check indicated that they considered this to be the primary objective of the Summer Institute and that that objective was achieved.

2. To foster interest in the field of medical engineering to bridge the gap between the engineering and medical professions - Unfortunately, the students were not polled at the beginning of the Institue with respect to their interest in a medical engineering career. However, two students indicated on their applications that they were interested in medical engineering as a career, and two others indicated that they felt this Institute would be a good opportunity to evaluate medical engineering as a potential career. In response to a question on interest in medical engineering in the final questionnaire, only two were not interested: Others were either interested or undecided. In any event, the first step in fostering interest was taken, that of providing insight into the problems and opportunities in the field of medical engineering.

3. To provide students with an awareness of the career opportunities available in scientific and engineering work in NASA - All students responding to the final questionnaire indicated that they would be interested in employment at GSFC following graduation. The achievement of this objective of the Summer Institute is due, in part, to impact of student contact with a number of GSFC personnel of various backgrounds. This interaction between students and professionals was perhaps the most important single element of the program. The interaction fulfilled the needs of the students with respect to assistance, expertise, and professionalism.

4. To generate a medium by which the existence and purpose of the Technology Utilization Program can be communicated to a number of engineering colleges - To the extent that four engineering colleges represented is considered "...a number of engineering colleges", this objective was achieved. All the students responding to the final questionnaire indicated emphatically that they would (a) discuss their participation in the Institute with fellow students, (b) discuss the NASA Technology Utilization Program with fellow students, and (c) recommend the program to interested fellow students. Copies of this report sent to the students would be valuable to them in this regard. It is further recommended that copies of this report be submitted to the NASA University Affairs Office to be provided to university engineering schools.

5. To provide students with an appreciation for the variety and sophistication of technology developed by NASA scientists and engineers - The students were quite impressed with the equipment available to the GSFC investigators. It was opportune that the Summer Institute was in progress at the time of the Appollo 11 mission, which impressed the students with the overall technology developed by NASA. Through informal discussions with the students, it was noted that they were impressed with the NASA-developed technology put to use in biomedical research sponsored by the NASA.

6. The sixth stated objective of this Summer Institute, to evaluate the potential of the Summer Program in achieving the above objectives so that consideration can be given to adoption of similar Summer Institutes at other NASA Centers, has been achieved to the extent that the Summer Institute did achieve the preceeding objectives. As to consideration being given to adoption of similar Summer Institutes at other NASA Centers, it is hoped that this report will be of some assistance in such consideration.

Outside of NASA/TUD objectives, the Summer Institute could provide a useful exposure relative to students' goals and practical educational objectives. The practical educational objectives would consist of the six stated program objectives, the first three of which are student-oriented goals and the last three NASA-oriented goals, plus two additional goals:

- growth of the student's technical/professional skills or knowledge;

- increase in the students' capability to interact in a professional environment.

These additional goals, even if measured on a subjective basis, appear to have been achieved.

It is too early at this time to determine whether or not the unstated objective of testing the validity of such a mechanism in accelerating the flow of NASA technology toward solutions to public problems was totally achieved. The contributions of the students and other participants of the Summer Institute are currently being evaluated, tested, and applied to the problems that were studied. it is generally felt that the short-term contributions were significant, Kenneth F. Jacobs indicates (see Appendix IV A 12) that the contributions "...answered a host of difficult engineering questions that the GW University staff estimated would have cost approximately $250,000 to achieve otherwise." When the results of the clinical application of this technology is known, it is expected that the last part of this objective (long-term goal) will be achieved.

It is not too early, however, to stress that the validity of this Summer Institute mechanism in accelerating the flow of NASA technology toward solutions to public problems could be tested in other NASA Centers and in other problem areas.

Future summer institute programs should be based on carefully thought-out objectives which take into consideration NASA goals, student needs, and behaviourally quantifiable educational objectives. That is, the program must of course meet NASA requirements and must be attractive to students relative to their preceived needs. The program should, as an educational experience, produce an observable change in objectively measurable student behavioral parameters.

APPENDIX

APPENDIX NO.	APPENDED MATERIAL
II A 1	Initial Summer Institute Proposal
2	Final Summer Institute Proposal
C 1	Action Items List
2	Boilerplate Information for GWU Proposal
3	GWU/BSCP Proposal
III A 1	Summer Institute Flier
2	Student Application Form
3	Form Letter of Acceptance
4-13	Student Biographical Sketches
14	Information Letter
15	GSFC Location Plan
16	GSFC/University of Maryland Map
17	Schedule of Events
18	Transportation and Housing Questionnaire
B 1	Lecture Schedule
2	Final Examination
C 1	Composite Information Sheet
IV A 1-10	Student Critiques
11	Program Evaluation Questionnaire
12	Jacobs' Comments and Recommendations
13-16	Comments of GSFC Technical Advisors

APPENDIX II A 1

PROPOSED SUMMER INSTITUTE

IN

TECHNOLOGY UTILIZATION

INTRODUCTION

It is proposed to conduct a Summer Institute in Technology Utilization in the summer, 1969. The Institute would be attended by engineering students who have completed their junior year in college. Each participant would receive full payment of tuition, fees and books, and a one day all-expense-paid field trip to the Goddard Institute for Space Studies. The program would be ten weeks in length, from June 23 to August 29, 1969, with the field trip occurring in the week of July 20.

The Institute would be part of the Summer Session of the George Washington University and would carry three points of academic credit at the graduate level in the School of Engineering Administration.

PURPOSES OF THE SUMMER INSTITUTE

The intent of the proposed program is multiple:

1. To provide students with an awareness of the career opportunities available in scientific and engineering work within NASA.

2. To provide students with an appreciation for the variety and sophistication of technology developed by NASA scientists and engineers.

3. To generate a medium by which the existence and purposes of the NASA Technology Utilization Program can be communicated to a number of engineering colleges.

4. To communicate to students an understanding of the scope, purposes, and methodology of government efforts in research and development activities.

5. To identify additional innovations and inventions for reporting under the NASA Technology Utilization Program by interviewing GSFC scientists and engineers and by documenting new technology items which might otherwise go unreported.

6. To evaluate the potential of the Summer Program in achieving the above objectives so that consideration can be given to adoption of similar Summer Institutes at other NASA centers.

SCOPE

It is intended to limit this Summer Institute to 10 to 15 senior college engineering students selected on the basis of an academic accumulative average of 3.0 or better. These will include out-of-state as well as local institutions.

ADMINISTRATION

Thru funding from Technology Utilization Division, NASA Headquarters, the George Washington University will be contracted to supply administrative action, hire students, and conduct an on-site graduate level three credit college course compatible with the Technology Utilization concepts.

FUNDING

The Technology Utilization Division, NASA Headquarters, has verbally requested (a formal request is forthcoming) program suggestions from GSFC to be funded by TUD. When informed of the concept of the Summer Institute in TU during the Functional Review this past December, they displayed an interest and suggested a contract directly with a university rather than a grant.

RATE OF PAY

To assure the interest and participation of top qualified students the level of pay will be approximately $100 per week (GS-5 equivalent).

HOUSING

The University of Maryland appears to be the most likely source of billeting for the students. Even under circumstances that do not involve that University, their dormitories should be available to us.

TRAVEL

The travel accommodations will be taken care of when appropriate information from the students is available. If the number of automobiles are not sufficient, WMA busses run from the University to GSFC regularly.

DURATION

The Summer Institute will be ten (10) weeks in length beginning 23 June and ending 29 August with one holiday (4th of July).

WORK ASSIGNMENTS

The students will be assigned to selected Divisions (preferably one per Division) to work under the stewardship of an assigned individual who will be responsible for his activities. During an eight hour work day he will interview GSFC scientists and engineers to uncover new technology items with publishability potential within the TU Program. The students will be responsible to gain an understanding of the item to the extent that they can put it into appropriate format for submission to the TUD Office.

Classroom sessions will be held twice a week (Tuesday and Thursday) from 8:00 to 10:00 A.M.

Guest speakers, presenting various aspects of the TU Program, will be invited on Wednesday. It is anticipated that five (5) such sessions will be held, one every other week.

FIELD TRIP

During the week of July 20, a one day visit to the Goddard Institute for Space Studies, New York, will be conducted.

ANNOUNCEMENT TO UNIVERSITIES

The acquisition of acceptable students by announcement of the program to participating institutions will be conducted by the George Washington University. It is felt that such an approach would expedite the program enrollment as well as assure an understanding between universities concerning the transfer of graduate course credits.

APPENDIX II A 2

SUMMER INSTITUTE FOR BIOMEDICAL RESEARCH IN TECHNOLOGY UTILIZATION

INTRODUCTION

It is proposed to conduct a Summer Institute in Technology Utilization in the summer, 1969, at the Goddard Space Flight Center, Greenbelt, Md. The Institute would be attended by engineering students who have completed their junior year in college. Each participant would receive full payment of tuition, fees, and books, and round-trip travel from home to GSFC and return. The program would be ten weeks in length, from June 23 thru August 29, 1969.

The Institute is to be part of the Summer Session of the George Washington University and would include a three-point accredited course at the graduate level in the School of Medical Engineering.

PURPOSES OF THE SUMMER INSTITUTE

1. To provide an opportunity for the students to engage in meaningful research directed toward the solution of selected engineering problems in the biomedical field.

2. To foster interest in the field of medical engineering to bridge the ever-widening gap between the engineering and medical professions.

3. To provide students with an awareness of the career opportunities available in scientific and engineering work within NASA.

4. To generate a medium by which the existence and purposes of the NASA Technology Utilization Program can be communicated to a number of engineering colleges.

5. To provide students with an appreciation for the variety and sophistication of technology developed by NASA scientists and engineers.

6. To evaluate the potential of the Summer Program in achieving the above objectives so that consideration can be given to adoption of similar Summer Institutes at other NASA centers.

SCOPE

It is intended to limit this Summer Institute to 10 senior engineering students selected on the basis of an academic accumulative average of 3.0

or better or upon specific endorsement by a faculty advisor. The intent of this Summer Institute is to acquire students with both an exceptional problem-solving ability and an interest in medical technology. The colleges may include out-of-state as well as local institutions.

These students will engage in actual research projects based on selected technical problems in the biomedical field. The case problems are products of an existing effort to apply NASA technology to pressing medical problems. It is known as the NASA TU Biomedical Application Team Program and is described in the attachment.

ADMINISTRATION AND FUNDING

The George Washington University, under a contract awarded and funded by the Technology Utilization Division, NASA Headquarters, will furnish administrative support, select and hire the students, and conduct the course which is compatible with the goals of the Summer Institute.

UNIVERSITY SELECTION

Justification for selecting the George Washington University is based on that institution's involvement in the NASA Biomedical Application Program. Their coordinator is Dr. Quentin L. Hartwig. This association will assure close coordination and support between the Summer Institute, GSFC, and the NASA Biomedical Application Program. George Washington University offers a graduate degree in Medical Engineering from which a three-credit course, having relevancy to the proposed Summer Institute, will be selected.

RATE OF PAY

To assure the interest and participation of top qualified students, the level of pay will be approximately $100 per week.

HOUSING

Housing arrangements will be the responsibility of the University. The cost will be incurred by the students.

TRAVEL

Round-trip travel expenses from the student's home to GSFC, and return, will be incurred by the University.

Travel from GSFC to the site of the course will be supplied by GSFC.

Travel to and from GSFC on a daily work basis will be the responsibility of the students.

DURATION

The Summer Institute will be ten (10) weeks in length, beginning 23 June and ending 29 August, with one holiday (4th of July).

WORK ASSIGNMENTS

Five teams of two students will be assigned to a GSFC research organizational unit under the supervision of a selected technical professional who will be responsible for their actions. They will perform engineering research on biomedical problems selected from a series of existing biomedical problem abstracts assigned to them by the course instructor. The facilities of the participating organizations will be at their disposal.

The course instructor will function on a full-time basis and would work at GSFC along with the students in a counseling, coordinating, and seminar-leading capacity.

The GSFC Medical Facility Director, Dr. Carlos Villafana, will be available for guidance to the students during their research activities.

ANNOUNCEMENT TO UNIVERSITIES

The acquisition of acceptable students by announcement of the program to institutions will be conducted by the George Washington University. It is felt that such an approach would expedite the program enrollment as well as assure an understanding between universities concerning the transfer of graduate course credits.

REPORT

The contract will include a requirement for the instructor to construct a report assessing the results of the Summer Institute. It is hoped that the report will be the basis of a publication in an appropriate journal. The report will be due within 60 days of the end of the Institute.

APPENDIX II C 1

16 May 1969

MEMORANDUM

TO : See List

FROM : John W. Johnston/BSCP

SUBJECT: Action Items

On the following page is a list of action items to be undertaken during the next month. This list was prepared during a meeting between Ken Jacobs and myself at Goddard on May 15, 1969.

If there are any questions or comments regarding the list or if there are additions, deletions, or modifications, please let me know as soon as possible.

JWJ:baf
encl: Action Item List

SUMMER INSTITUTE IN TECHNOLOGY UTILIZATION

ACTION ITEMS

May 15 - June 15, 1969

COMPLETION DATE	ACTIONS	RESPONSIBILITY
5/16/69	Send final student list to Johnston	GWU EE/Eisenberg
5/19/69	Acquire final student list	BSCP/Johnston
5/21/69	Send first day instructions, maps, etc. to BSCP	GSFC/Jacobs
5/21/69	Send questionnaires to students	BSCP/Johnston
5/21/69	Request backup data from teams on problems	BSCP/Johnston
5/30/69	Arrange for GSFC labs, equip., mentors	GSFC/Jacobs(Flei
5/30/69	Arrange for student billeting of U. of Md.	GSFC/Jacobs
5/30/69	Arrange for work order details	GSFC/Jacobs
6/2/69	Acquire student responses	BSCP/Johnston
6/2/69	Write up travel pay procedure	BSCP/Johnston
6/2/69	Write up stipend pay procedure	BSCP/Johnston
6/6/69	Finalize housing arrangements	GSFC/Jacobs
6/9/69	Prepare BSCP orientation outline	BSCP/Johnston
6/9/69	Prepare GSFC orientation outline	GSFC/Jacobs
6/13/69	Check on texts, materials for course	BSCP/Johnston

MAILING LIST

NASA/TUD Hq.

R. Philips
J. Richards

NASA/GSFC

Ken Jacobs

GWU/BSCP

C. Shilling
Q. Hartwig
J. Johnston

GWU/Eng.

L. DePian
M. Eisenberg
R. Fowler

APPENDIX II C 2

Proposal to the National Aeronautics and Space Administration for Support of the 1969 Summer Institute for Biomedical Research in Technology Utilization

(example of signature level which might be appropriate)

Dean Smith	Dr. Schilling
Prof. DePian	Finance Officer

submitted by: the George Washington University in cooperation with the NASA-Goddard Space Flight Center

I. Description of Proposed Program

(use format of entire description prepared by Ken Jacobs)

II. Administration

The program shall be administered by the following Company Directors from the participating organizations:

1. Prof. Eisenberg, (title)
   -Technical Program Director

2. Mr. John Johnston, (title)
   -Administrative Director

3. Mr. Kenneth Jacobs, Technology Utilization Officer, NASA-Goddard Space Flight Center
   -Goddard Coordinator

III. Program Budget

a. Technical Program Director (Prof. Eisenberg)
   -1/3 of annual salary $_____

b. Secretarial Salary
   -1/3 of annual salary $_____

c. Honoraria for quest lecturers, Short-course Staff (other than Technical Program Director)
   $_____

d. Student Fellowships
   -10 at $100/wk for 10 weeks $10,000.

e. Travel & Relocation Allowance for Student
   -(estimate) 10 at $200 ea. $2,000.

f. Communications, supplies & other miscellaneous expenses (direct)
   -(estimate) $1,000.

g. Recruiting Expenses
   -(estimate) $500.

APPENDIX II C 3

A Proposal

to

The Technology Utilization Division

National Aeronautics and Space Administration

Washington, D.C.

to

Amend Existing Contract NSR-09-010-035

by the Addition of a Task Order

for

SUPPORT OF THE 1969 SUMMER INSTITUTE FOR

BIOMEDICAL RESEARCH IN TECHNOLOGY UTILIZATION

Submitted by

Biological Sciences Communication Project

The George Washington University Medical Center

29 April 1969

Charles W. Shilling, M.D., Director
Biological Sciences Communication Project

SUMMER INSTITUTE FOR BIOMEDICAL RESEARCH IN TECHNOLOGY UTILIZATION

I. PROPOSED PLAN

It is proposed that the Biological Sciences Communication Project of The George Washington University coordinate a ten-week Summer Institute for Biomedical Research in Technology Utilization from June 23 to August 29, 1969. This Institute, as proposed, would provide ten senior engineering students with the opportunity of participating in a program to utilize NASA technology to solve definitive biomedical problems. As part of the Institute, the students would attend the Summer Session of The George Washington University in an accredited three-credit course entitled, "Introduction to Medicine for Engineers" to be presented by the School of Engineering, and held at The George Washington University Hospital. The remainder of the student's time will be spent at the NASA Goddard Space Flight Center proposal entitled, "Summer Institute for Biomedical Research in Technology Utilization," a facsimile of which is appended.

II. CONTRACT ARRANGEMENTS

It is further proposed that the conduct of this Summer Institute be considered as an additional task under the present NASA Contract #NSR-09-010-035 with the Biological Sciences Communication Project of The George Washington University. The following is a proposed addition to the Work Statement of that contract which would provide for conduct of the Summer Institute:

> Additionally, the contractor shall, in cooperation with the NASA Goddard Space Flight Center, conduct a ten-week Summer Institute for Biomedical Research in Technology Utilization to be held from June 23 to August 29, 1969. As part of this task, the Contractor will provide necessary funds for tuition, books, fees, travel to and from the Institute, student stipends, and instructors' fees. In addition, the con-

tractor will provide the necessary management and coordinating effort for day-to-day operation of the Institute.

III. PROGRAM RESPONSIBILITIES

As proposed, this Summer Institute is to be conducted through the cooperative efforts of the School of Engineering and Biological Sciences Communication Project of The George Washington University and of the NASA Goddard Space Flight Center. The following is a listing of the areas of responsibilities of each of these three groups:

A. NASA Goddard Space Flight Center

The Goddard Space Flight Center will arrange for housing for the ten students, will furnish transportation from the Center to The George Washington University Hospital on the days of the lecture, and will completely oversee the applied research effort of the ten students.

B. The George Washington University School of Engineering

The Engineering School of the University has selected the professors for the conduct of the lecture course who will be Dr. Eisenberg and Dr. Fowler. They have identified three possible assistants of whom two will be chosen to spend full time with the ten students to make certain that their research effort is productive. The names of the three are: Mr. Adams, Mr. Malik and Mr. Zeskind. The Engineering School has also prepared the material for a flier which will be distributed to all of the engineering schools in the United States. We recognize that this is too late to be of any great value, but it is felt to be desirable from the standpoint of good public relations for both NASA and The George Washington University. Dr. H.E. Smith of the Engineering School has called many

of his friends in other institutions and will select the ten for this summer's activity. Dr. Eisenberg will be responsible for writing the academic report of the summer's activity.

C. The George Washington University Biological Sciences Communication Project

The B.S.C.P. make available to a special committee a list of possible research tasks for the students to undertake during the summer. From this representatives from the Engineering School, from Goddard, and from the B.S.C.P. will finally select five research tasks for the five teams to work on during the ten weeks. The overall role of the B.S.C.P. has become one of a general management function. Mr. John W. Johnston will spend one half of his time attending the lectures and working with the students and in general management to make certain that all the efforts are coordinated so as to produce the best possible results. Mr. Johnston will also put in a report which covers the total effort in all of its detail in addition to the educational report planned for by the Engineering School.

The B.S.C.P. will also be responsible for the total fiscal activity involved in the summer institute. The B.S.C.P. has prepared the present proposal which it is requested will become part of the general contract NASA #09-010-035 as soon as possible. B.S.C.P. will be responsible for seeing that the students are paid, that their transportation from their home base to Washington and return is taken care of, and that the Engineering School is reimbursed for its activity.

IV. ESTIMATED BUDGET - THREE MONTHS

A. Salaries and Wages

Faculty		
Dr. Eisenberg (50%)	2,250.00	
Dr. Fowler (25%)	1,500.00	
Academic Assistant (100%)	2,000.00	
School of Medicine Lecturers (10 lectures @ $75)	750.00	
Secretary (50%)	750.00	
J. Johnston (50%) (time released from NASA 035)	-	
Total Personnel		7,250.00

B. Fringe Benefits (16.5% S&W)* 1,197.00

Indirect Costs (35.08% S&W Provisional Rate) 2,544.00

C. Student Expenses

Student Stipend (10 students @ $1,000)	10,000.00	
Books	150.00	
Travel	1,500.00	
Total		11,650.00

D. Communications (Mailing and LD Telephone) 200.00

E. Reproduction and Duplication (Print flier, reports, etc.) 250.00

F. Supplies 150.00

G. Travel (Local - staff) 100.00

TOTAL ESTIMATED COST $23,341.00

*The total salary and wage amount shown herein provides for direct labor effort in the percentages for hours expressed herein for the budget period. The fringe benefit rate is a package rate which provides for several benefits including vacation and sick leave earned in accordance with University policy.

V. BUDGET JUSTIFICATION

A. Salaries and Wages.

This entire item covers the effort to be expended by members of the Engineering School. Mr. Johnston's 50% is calculated as released time from NASA 035.

B. Fringe Benefits and Indirect Costs.

Self explanatory.

C. Student Expenses.

The BSCP will undertake to pay the students $100 a week for the ten week period. Tuition and fees will be transferred to the Engineering School. Books, as required for the course, will be paid for through the BSCP. Travel will cover only the cost of coming from their university to Washington and return to the university.

D. Communication.

Self explanatory.

E. Reproduction and Duplication.

Self explanatory.

F. Supplies.

Self explanatory.

Latest Edition

From: K. Jacobs
9-22-69

SUMMER INSTITUTE FOR BIOMEDICAL RESEARCH

IN TECHNOLOGY UTILIZATION

INTRODUCTION

It is proposed to conduct a Summer Institute in Technology Utilization in the summer, 1969, at the Goddard Space Flight Center, Greenbelt, Md. The Institute would be attended by engineering students who have completed their junior year in college. Each participant would receive full payment of tuition, fees and books, and round-trip travel from home to GSFC and return. The program would be ten weeks in length, from June 23 thru August 29, 1969.

The Institute is to be part of the Summer Session of the George Washington University and would include a three-point accredited course at the graduate level in the School of Medical Engineering.

PURPOSES OF THE SUMMER INSTITUTE

1. To provide an opportunity for the students to engage in meaningful research directed toward the solution of selected engineering problems in the biomedical field.

2. To foster interest in the field of medical engineering to bridge the ever-widening gap between the engineering and medical professions.

3. To provide students with an awareness of the career opportunities available in scientific and engineering work within NASA.

4. To generate a medium by which the existence and purposes of the NASA Technology Utilization Program can be communicated to a number of engineering colleges.

5. To provide students with an appreciation for the variety and sophistication of technology developed by NASA scientists and engineers.

6. To evaluate the potential of the Summer Program in achieving the above objectives so that consideration can be given to adoption of similar Summer Institutes at other NASA centers.

SCOPE

It is intended to limit this Summer Institute to 10 senior engineering students selected on the basis of an academic accumulative average of 3.0 or better or upon specific endorsement by a faculty advisor. The intent of this Summer Institute is to acquire students with both an exceptional problem-solving ability and an interest in medical technology. The colleges may include out-of-state as well as local institutions.

These students will engage in actual research projects based on selected technical problems in the biomedical field. The case problems are products of an existing effort to apply NASA technology to pressing medical problems. It is known as the NASA TU Biomedical Application Team program and is described in the attachment.

ADMINISTRATION AND FUNDING

The George Washington University, under a contract awarded and funded by the Technology Utilization Division, NASA Headquarters, will furnish administrative support, select and hire the students, and conduct the course which is compatible with the goals of the Summer Institute.

UNIVERSITY SELECTION

Justification for selecting the George Washington University is based on that institution's involvement in the NASA Biomedical Application Program. Their coordinator is Dr. Quentin L. Hartwig. This association will assure close coordination and support between the Summer Institute, GSFC, and the NASA Biomedical Application Program. George Washington University offers a graduate degree in Medical Engineering from which a three-credit course, having relevancy to the proposed Summer Institute, will be selected.

RATE OF PAY

To assure the interest and participation of top qualified students, the level of pay will be approximately $100 per week.

HOUSING

Housing arrangements will be the responsibility of the University. The cost will be incurred by the students.

TRAVEL

Round-trip travel expenses from the student's home to GSFC, and return, will be incurred by the University.

Travel from GSFC to the site of the course will be supplied by GSFC.

Travel to and from GSFC on a daily work basis will be the responsibility of the students.

DURATION

The Summer Institute will be ten (10) weeks in length, beginning 23 June and ending 29 August, with one holiday (4th of July).

WORK ASSIGNMENTS

Five teams of two students will be assigned to a GSFC research organizational unit under the supervision of a selected technical professional who will be responsible for their actions. They will perform engineering research on biomedical problems selected from a series of existing biomedical problem abstracts assigned to them by the course instructor. The facilities of the participating organizations will be at their disposal.

The course instructor will function on a full-time basis and would work at GSFC along with the students in a counseling, coordinating, and seminar-leading capacity.

The GSFC Medical Facility Director, Dr. Carlos Villafana, will be available for guidance to the students during their research activities.

ANNOUNCEMENT TO UNIVERSITIES

The acquisition of acceptable students by announcement of the program to institutions will be conducted by the George Washington University. It is felt that such an approach would expedite the program enrollment as well as assure an understanding between universities concerning the transfer of graduate course credits.

REPORT

The contract will include a requirement for the instructor to construct a report assessing the results of the Summer Institute. It is hoped that the report will be the basis of a publication in an appropriate journal. The report will be due within 60 days of the end of the Institute.

THE GEORGE WASHINGTON UNIVERSITY

School of Engineering and Applied Science

announces a

SUMMER INSTITUTE IN BIOMEDICAL RESEARCH IN TECHNOLOGY UTILIZATION

APPENDIX III A 1

Sponsored by the

Goddard Space Flight Center
National Aeronautics and Space Administration

JUNE 23---AUGUST 29, 1969

UNDERGRADUATE GRANTS

The Program of the Summer Institute

The Goddard Space Flight Center of NASA is seriously concerned with the utilization of the technology developed under its operational and research programs. The Center desires to provide, in cooperation with the School of Engineering and Applied Science of The George Washington University, a summer institute in biomedical science and technology which will enable a selected group of students to spend ten (10) weeks this summer in study of these programs of NASA under the supervision of and in concert with Faculty and engineers and scientists of Goddard Space Flight Center and to undertake a specific course of instruction in Engineering Introduction to Medicine (EE 181).

Selected students will have tuition and books provided for a three semester hour credit course, will be paid $100 a week for 10 weeks activity. Travel to Washington and return home will also be provided.

The Institute provides an opportunity in this inter-disciplinary effort for the imaginative student to gain new outlooks and face real challenges. He will be involved in use of knowledge of the field of biomedical research and technology that demonstrates the technical and economic feasibility of designs or research results that support living systems or that enhance the performance of living systems. The student's specialization in an engineering discipline will influence his interests and motivation in study of bioengineering during the Institute's period of study. Students will engage in actual research projects. The case problems are products of an existing effort to apply NASA technology to pressing medical problems. This effort is known as the NASA Biomedical Application Team program. Guidance to the students during their research activities will be available.

Requirements for Admission

To be eligible, the students should have completed their junior year by June 1969 and be enrolled in an American college or university. Students will be selected on the basis of their academic record and/or recommendation of their faculty advisor.

Students who desire to avail themselves of attendance should write to Professor Louis dePian, School of Engineering and Applied Science, The George Washington University, Washington, D. C. 20006 for an application form. Students should submit a transcript (or a list of all college courses and grades accompanied by latest grade slip) and a letter from his advisor.

The deadline for receipt of applications is May 31, 1969

THE GEORGE WASHINGTON UNIVERSITY
School of Engineering and Applied Science

APPLICATION
for Participation in the

SUMMER INSTITUTE IN BIOMEDICAL RESEARCH
AND ENGINEERING UTILIZATION

June 23--August 29, 1969

Name _____
Last First Middle

Address _____

_____

Telephone _____ _____
Area Code

Current Institution _____

Degree Sought _____

Grade Quality Index _____ Max. Scale _____

_____
Applicant's Signature

_____
Date

Please attach a statement as to your reason for desiring to participate in this Program and a transcript of your studies.

June 10, 1969

Mr. Harold John Althouse
257 Congressional Lane
Apartment #313
Rockville, Maryland 20852

Dear Mr. Althouse:

I am happy to inform you that you are admitted to the Summer Institute in Biomedical Research in Technology Utilization for the Summer 1969.

You will shortly receive additional information with instructions and details for this program.

Sincerely,

Louis de Pian

LdP/saw

APPENDIX III A 4

STUDENT BIOGRAPHICAL SKETCH

NAME: Harold John Althouse S.S. NO: [redacted]

CURRENT ADDRESS: 257 Congressional Lane, Rockville, Md. 20852

HOME PHONE NO: 427-4736 MARITAL STATUS: Married

DATE OF BIRTH: [redacted] PLACE OF BIRTH: Washington, D.C.

CURRENT INSTITUTION: George Washington University

DEGREE SOUGHT: BSEE

GRADE QUALITY INDEX: 3.535 MAXIMUM SCALE: 4.000

SPECIAL INTERESTS: None mentioned; plans to attend graduate school.

REASONS FOR DESIRING TO PARTICIPATE IN SUMMER INSTITUTE:

1. Program would afford valuable practical experience.
2. Likes opportunity to work on useful project.
3. NASA's modern facilities.
4. Gives opportunity to evaluate medical engineering as possible career.

APPENDIX IIIA 5

STUDENT BIOGRAPHICAL SKETCH

NAME: David Russell Armstrong S.S. NO: [redacted]

CURRENT ADDRESS: 105 South Fenwick Street, Arlington, Va. 22204

HOME PHONE NO: 528-1446 MARITAL STATUS: Single

DATE OF BIRTH: [redacted] PLACE OF BIRTH: Washington, D.C.

CURRENT INSTITUTION: George Washington University

DEGREE SOUGHT: BSEE

GRADE QUALITY INDEX: 2.9 MAXIMUM SCALE: 4.0

SPECIAL INTERESTS: Journalism (Presently editor-in-chief of Mecheleciv magazine, student's magazine of GWU School of Engineering), astronomy, astrophotography.

REASONS FOR DESIRING TO PARTICIPATE IN SUMMER INSTITUTE:

1. Wants summer job to give experience and training.
2. Interested in NASA and R&D.

STUDENT BIOGRAPHICAL SKETCH

NAME: Jacob Marshall Azrael S.S. NO: [redacted]

CURRENT ADDRESS: 636 Leafydale Terrace, Baltimore, Md. 21209

HOME PHONE NO: HU4-3849 MARITAL STATUS: Single

DATE OF BIRTH: [redacted] PLACE OF BIRTH: Baltimore, Md.

CURRENT INSTITUTION: George Washington University

DEGREE SOUGHT: BSEE

GRADE QUALITY INDEX: 2.89 MAXIMUM SCALE: 4.00

SPECIAL INTERESTS: Photograph, electronics.

REASONS FOR DESIRING TO PARTICIPATE IN SUMMER INSTITUTE:

None given.

STUDENT BIOGRAPHICAL SKETCH

NAME: Louis Richard Biosca S.S. NO: [redacted]

CURRENT ADDRESS: 500 Beverly Avenue, Mayo, Maryland 21106

HOME PHONE NO: 798-1491 MARITAL STATUS: Married

DATE OF BIRTH: [redacted] PLACE OF BIRTH: Teaneck, N.J.

CURRENT INSTITUTION: University of Maryland

DEGREE SOUGHT: BSEE

GRADE QUALITY INDEX: 2.2 MAXIMUM SCALE: 4.0

SPECIAL INTERESTS: Application of computers to medicine, particularly in diagnostics.

REASONS FOR DESIRING TO PARTICIPATE IN SUMMER INSTITUTE:

Wishes to come in contact with medical engineering.

APPENDIX III A 8

STUDENT BIOGRAPHICAL SKETCH

NAME: John Clay Davies III S.S. NO: [redacted]

CURRENT ADDRESS: 3400 Sleepy Hollow Road, Falls Church, Va. 22044

HOME PHONE NO: 534-5530 MARITAL STATUS: Single

DATE OF BIRTH: [redacted] PLACE OF BIRTH: Montclair, N

CURRENT INSTITUTION: George Washington University

DEGREE SOUGHT: BSEE

GRADE QUALITY INDEX: 3.0 MAXIMUM SCALE: 4.0

SPECIAL INTERESTS: Computer Applications and Networks

REASONS FOR DESIRING TO PARTICIPATE IN SUMMER INSTITUTE:

1. Opportunity to participate in biomedical research.
2. Ample stipend for summer.
3. Attainment of research techniques.

APPENDIX III A 9

STUDENT BIOGRAPHICAL SKETCH

NAME: Jeffrey Cornell Greene S.S. NO: [redacted]

CURRENT ADDRESS: 137 Yancey Street, Tuskegee, Alabama 36083

HOME PHONE NO: 205-727-3181 MARITAL STATUS: Single

DATE OF BIRTH: [redacted] PLACE OF BIRTH: Tuskegee, Ala.

CURRENT INSTITUTION: Auburn University

DEGREE SOUGHT: BS in Aerospace Engineering

GRADE QUALITY INDEX: 2.00 MAXIMUM SCALE: 3.00

SPECIAL INTERESTS: Computer programming/operation, Mathematics

REASONS FOR DESIRING TO PARTICIPATE IN SUMMER INSTITUTE:

Interested in NASA work in human support systems.

STUDENT BIOGRAPHICAL SKETCH

NAME: Mohammed Hassan Hatoum S.S. NO: [redacted]

CURRENT ADDRESS: 1260 21st St., N.W., Washington, D.C. 20036

HOME PHONE NO: 223-0751 MARITAL STATUS: Married

DATE OF BIRTH: [redacted] PLACE OF BIRTH: Lebanon

CURRENT INSTITUTION: George Washington University

DEGREE SOUGHT: BSEE

GRADE QUALITY INDEX: 3.3 MAXIMUM SCALE: 4.0

SPECIAL INTERESTS: Computer applications in medical engineering

REASONS FOR DESIRING TO PARTICIPATE IN SUMMER INSTITUTE:

1. Plans to do graduate work in medical engineering.
2. More meaningful summer employment.

APPENDIX III A 11

STUDENT BIOGRAPHICAL SKETCH

NAME: Vivic Loare Johnson S.S. NO: [redacted]

CURRENT ADDRESS: 1715 Minnesota Ave., S.E., Washington, D.C. 20020

HOME PHONE NO: 581-2446 MARITAL STATUS: Married

DATE OF BIRTH: [redacted] PLACE OF BIRTH: Kingston, Ja.

CURRENT INSTITUTION: Howard University

DEGREE SOUGHT: BSEE

GRADE QUALITY INDEX: 3.3 MAXIMUM SCALE: 4.0

SPECIAL INTERESTS: None mentioned

REASONS FOR DESIRING TO PARTICIPATE IN SUMMER INSTITUTE:

Plans to do graduate work in medical engineering.

APPENDIX III A 12

STUDENT BIOGRAPHICAL SKETCH

NAME: Philip Youn-Lim Ong S.S. NO: [redacted]

CURRENT ADDRESS: 2701 Albemarle St., N.W., Washington, D.C. 20008

HOME PHONE NO: 362-0400 MARITAL STATUS: Single

DATE OF BIRTH: [redacted] PLACE OF BIRTH: Malaysia

CURRENT INSTITUTION: George Washington University

DEGREE SOUGHT: BSEE

GRADE QUALITY INDEX: 2.2 MAXIMUM SCALE: 4.0

SPECIAL INTERESTS: None mentioned

REASONS FOR DESIRING TO PARTICIPATE IN SUMMER INSTITUTE:

"Failed elective in Senior year - did not graduate!

- need summer job to survive."

STUDENT BIOGRAPHICAL SKETCH

NAME: Leonard Benjamin Sirota S.S. NO: [redacted]

CURRENT ADDRESS: 736 22nd St., N.W., Washington, D.C. 20006

HOME PHONE NO: 223-4350 MARITAL STATUS: Single

DATE OF BIRTH: [redacted] PLACE OF BIRTH: Boston, Mass.

CURRENT INSTITUTION: George Washington University

DEGREE SOUGHT: BSEE

GRADE QUALITY INDEX: 2.4 MAXIMUM SCALE: 4.0

SPECIAL INTERESTS:

REASONS FOR DESIRING TO PARTICIPATE IN SUMMER INSTITUTE:

1. Plans to do graduate work in medical engineering.
2. Will provide invaluable instruction and experience.

June 2, 1969

Mr. Harold Althouse
257 Congressional Lane
Apt. #313
Rockville, Maryland 20852

Dear Mr. Althouse:

This is some additional information on the Summer Institute for Biomedical Research in Technology Utilization.

1. The Institute will consist of two parts, lecture and research.

The lecture portion of the Institute will involve two four-hour lecture periods per week for five weeks to be held at the George Washington University Hospital. The specific course of instruction is EE 181, Introduction to Medicine for Engineers. The lectures will be given jointly by a Professor of Electrical Engineering and a physician with engineering background. Guest lectures will be given by specialists from the hospital. A discussion period will follow each lecture.

The preponderance of your time will be spent at the Goddard Space Flight Center engaged in biomedical engineering research on actual medical problems defined by the Biomedical Applications Program of NASA's Technology Utilization Division. To most effectively deal with these problems, the student group will be divided into teams of two and will be assigned defined problems for study. Each team will be assigned to an appropriate GSFC Laboratory in which to conduct their research. A GSFC Scientist or Engineer will be available to each team for advice and consultation and there will be a predoctoral graduate student from the GWU School of Engineering available at GSFC for coordination. Necessary instruments, materials, etc., may be requested by GSFC Work Order Requisitions processed through the GSFC Technology Utilization Officer or his designated representative.

2. For your further information, enclosed is a packet of data on NASA in general, GSFC in particular, and the Biomedical Applications Program of the NASA Technology Utilization Division. Also in the packet are supplementary information such as maps, and schedules. Please let me know if you need additional information.

3. Please note the enclosed questionnaire. Complete and return the questionnaire as soon as possible so that transportation and housing may be arranged.

If there are any questions, do not hesitate to call me at 202-462-5828. I look forward to seeing you on June 23.

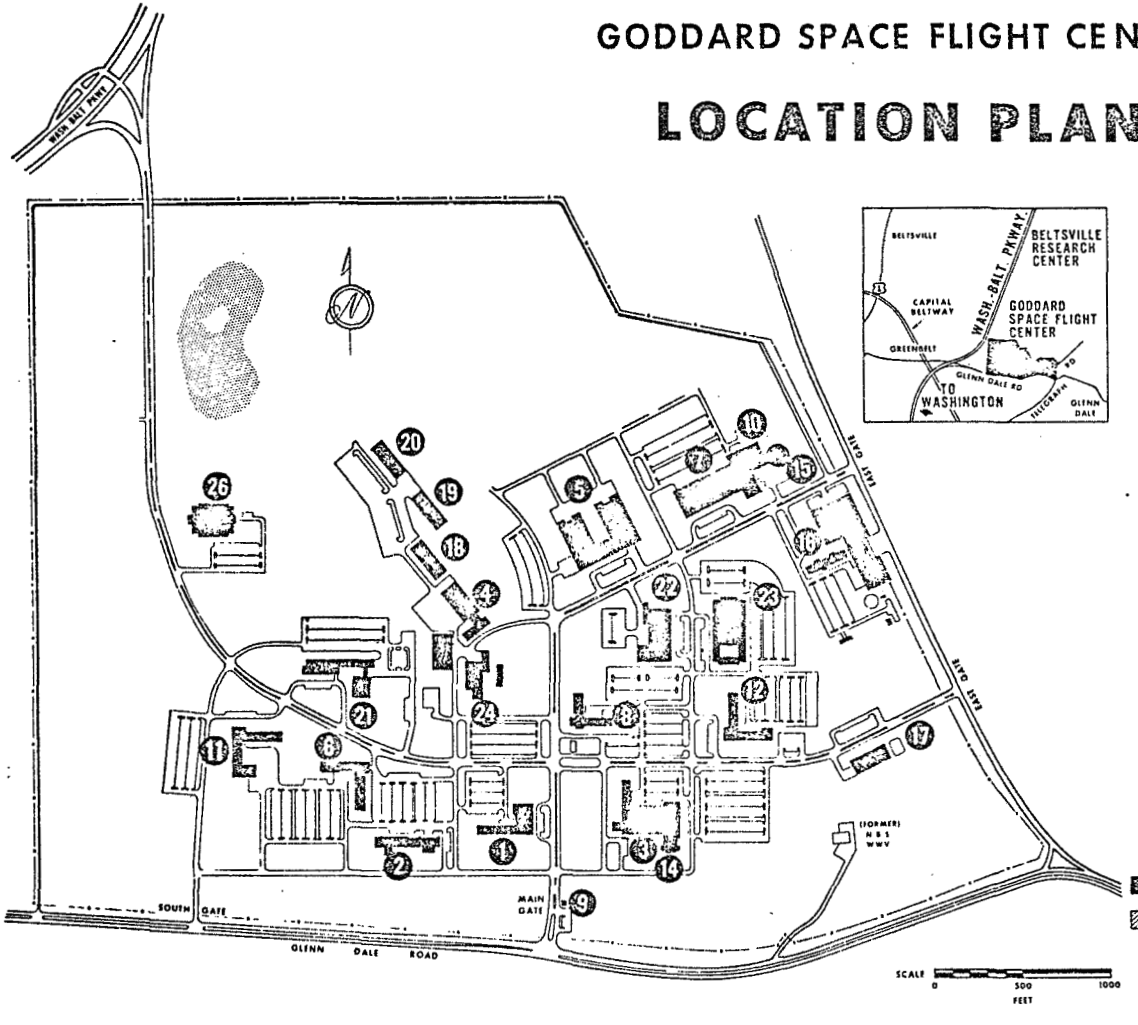
Sincerely,

John W. Johnston
Research Scientist

JWJ:baf
encl: information packet
questionnaire

GODDARD SPACE FLIGHT CENTER

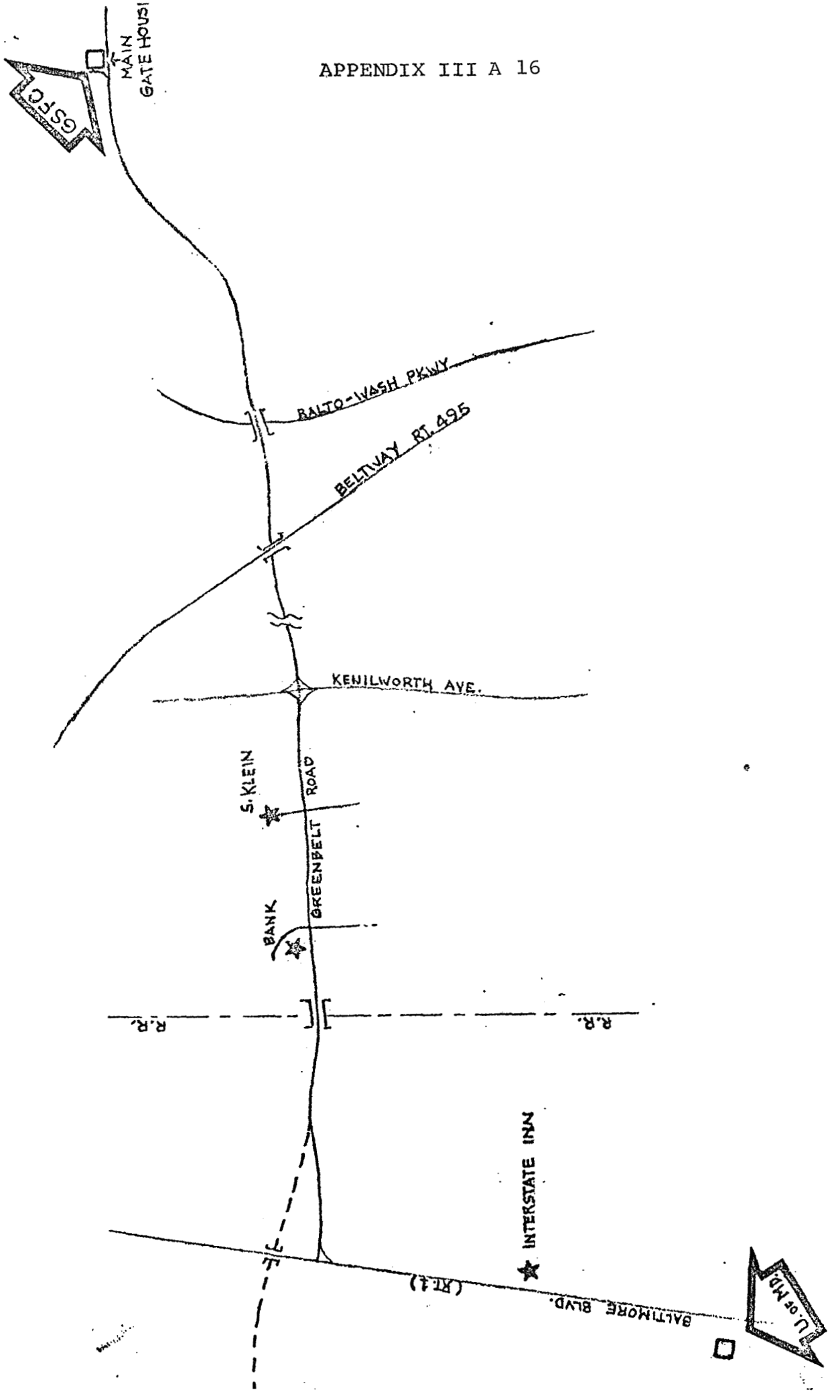
LOCATION PLAN



1. SPACE PROJECTS BUILDING
2. RESEARCH PROJECTS LABORATORY
3. CENTRAL FLIGHT CONTROL AND RANGE OPERATIONS LABORATORY
5. BOILER HOUSE AND ELECTRIC SUBSTATION
6. INSTRUMENT CONSTRUCTION AND INSTALLATION LABORATORY
7. SPACE SCIENCES LABORATORY
8. PAYLOAD TESTING FACILITY
9. SATELLITE SYSTEMS LABORATORY
9. GATE HOUSE
10. ENVIRONMENTAL TESTING LABORATORY
11. APPLIED SCIENCES LABORATORY
12. TRACKING AND TELEMETRY LABORATORY
14. SPACECRAFT OPERATIONS FACILITY
15. LAUNCH PHASE SIMULATOR
16. DEVELOPMENT OPERATIONS BUILDING
17. MULTI–PURPOSE BUILDING
18. MULTI–PURPOSE BUILDING
19. MULTI–PURPOSE BUILDING
20. MULTI–PURPOSE BUILDING
21. METEOROLOGICAL SYSTEMS DEVELOPMENT LABORATORY
22. MECHANICAL TEST FACILITY AND QUALITY ASSURANCE LABORATORY
23. DATA INTERPRETATION LABORATORY
24. ADDITION TO CENTRAL HEATING AND REFRIGERATION PLANT
26. NASA SPACE SCIENCE DATA CENTER

EXISTING FACILITIES

FACILITIES UNDER CONSTRUCTION


GSFC
MAIN GATE HOUSE
BALTO-WASH PKWY
BELTWAY RT. 495
KENILWORTH AVE.
S. KLEIN
GREENBELT ROAD
BANK
R.R.
R.R.
INTERSTATE INN
(RT.1)
BALTIMORE BLVD.
U. OF MD.

GODDARD SPACE FLIGHT CENTER

SUMMER INSTITUTE FOR BIOMEDICAL RESEARCH
IN TECHNOLOGY UTILIZATION

I. Schedule of Events

A. Monday, 23 June

8:00 A.M. Report to Main Gate House*

8:15 A.M. Meet in Building 8, GSFC, Director's Conference Room, 6th Floor

8:30 A.M. Welcoming Address by Dr. Michael J. Vaccaro, Assistant Director for Administration and Management

9:00 A.M. Program Briefing by K. F. Jacobs, Technology Utilization Officer, GSFC

10:00 A.M. Center Tour

12:00 Lunch

1:00 P.M. Tour of Medical Facility

2:00 P.M. Check-In Process at Gatehouse (Bldg. #9)

2:30 P.M. Reconvene at Director's Conference Room

2:45 P.M. Films: (1) TU Program
(2) Apollo

*Identify yourself as partaking in a Special Tour for Summer Institute in Technology Utilization; you will be directed by the receptionist.

B. Tuesday, 24 June

8:00 A.M. Report to Building 8 Conference Room 518

GSFC/Summer Institute for
Biomedical Research in
Technology Utilization

Schedule of Events (continued)

B. Tuesday, 24 June (continued)

8:15 A.M. Presentation by: Mr. Ronald J. Philips,
Director
Technology Utilization Divisio
NASA Headquarters
Subject: "Technology Utilization -
An Overview"

9:15 A.M. Presentation by: Dr. Quentin L. Hartwig,
Sr. Staff Scientist,
BSCP (BATeams)
George Washington University
Subject: "NASA's Biomedical Application
Teams Program"

10:15 A.M. Presentation by: Miss Adelaide Del Frate,
GSFC Librarian
Subject: "How to Use NASA's Infor-
mation Systems"

11:15 A.M. Lunch

12:15 P.M. Vehicle Departs for George Washington
University Hospital

1:00 P.M. 1st Class Session Begins

5:00 P.M. Vehicle Returns to GSFC

C. Wednesday, 25 June

8:00 A.M. Report to Building 1

8:15 A.M. Vehicle Departs for Biological Sciences
Communications Project , G. W. University,
for a Day-Long Orientation of Facility
and Systems

GSFC/Summer Institute for
Biomedical Research in
Technology Utilization

Schedule of Events (continued)

C. Wednesday, 25 June (continued)

3:30 P.M. Vehicle Returns to GSFC

4:00 P.M. Meet in Building 8 - Technology Utilization Office for Assignment of Laboratories & GSFC Mentors (Room 439)

D. Class Schedule/Transportation

1. Classes will be conducted at the George Washington University Hospital each Tuesday and Thursday afternoon from 1:00 P.M. to 5:00 P.M. Specifically, the dates are:

June 24, 26.
July 1, 3, 8, 10, 15, 17, 22, 24.

2. Transportation from GSFC to the Hospital and return will be provided in strict accordance with the following schedule:

.Leave Building #1, GSFC, at 12:15 P.M.
.Leave Hospital (at point of arrival) at 5:15 P.M.

APPENDIX III A 18

SUMMER INSTITUTE FOR BIOMEDICAL RESEARCH
IN TECHNOLOGY UTILIZATION

STUDENT QUESTIONNAIRE

PERSONAL

Full Name:_____ S.S. No.:_____

Home Address:_____

Home Phone No:_____ Marital Status:_____

Date of Birth:_____ Place of Birth:_____

Special Interests:_____

_____

HOUSING

Will you require dormitory housing while attending the Summer Institute?
( )YES ( )NO

Dormitory housing will be available at the University of Maryland, which is within a seven mile radius of the Goddard Space Flight Center. If you require dormitory housing, please check ( )single or ( )double. The cost of this housing will be incurred by you. If you are interested, you will be notified of rates.

If not, please provide the address of your residence while attending the Institute:

_____

_____

_____

TRANSPORTATION

Will you require transportation from your current institution to Washington and return? ( )YES ( )NO

The cost of transportation will be incurred by the Institute. Commercial carrier tickets will be provided.

Will you have a car while at the Institute? ( )YES ( )NO if so, would you be willing to assist other students in transportation? ( )YES ( )NO

Please return this questionnaire to:

SUMMER INSTITUTE FOR BIOMEDICAL RESEARCH
IN TECHNOLOGY UTILIZATION
Biological Sciences Communication Project
George Washington University Medical Center
2000 P. Street, N.W. Suite 700
Washington, D.C. 20036

APPENDIX III B 1

1969

LECTURE SCHEDULE

NASA - SUMMER SESSION IN MEDICAL ENGINEERING

PLACE: Pathology Conference Room - 4th Floor - GWUH

TIME : 1:30 o'clock P.M.

DATE:	SUBJECT	LECTURER
June 24	Introduction, Project Description, (Ultrasonics and Activity Monitor)	R.C. Fowler, M.D. M.F. Eisenberg, Ph.D.
June 26	Pathology and Clinical Labs	T.M. Peery, M.D.
July 1	Cardiovascular System	J.B. Calatayud, M.D.
July 3	Neurology Hematology	H. Stevens, M.D. E. Adelson, M.D.
July 8*	Sensory: Eyes Speech & Hearing	J. Goldman J.W. Hillis, Ph.D.
July 11	Pulmonary Functions	H.M. Silver, M.D.
July 15	Rehabilitation and Evoked Responses	R.C. Fowler, M.D. I. Tamagna, M.D. M.F. Eisenberg, Ph.D.
July 17	Genito Urinary Tract and Electrolyte Balance Hospital Administration	N.C. Kramer, M.D. G. Friesen, M.D.
July 22	Endocrinology and Oncology	L.K. Alpert, M.D.
July 24	Review	

*Location to be announced

PART I (continued)

23. _____ near or nearest to, used in contradistinction to -

24. _____ far away from.

25. _____ pertaining to the front or abdominal surface.

PART II. True-False; circle either the "T" (true) or "F" (false) to the left of the statement.

1. T F The period of relaxation following contraction is called diastole.

2. T F Arterial blood is always at a higher pressure than venous blood.

3. T F Kidneys produce urine, regulate blood pressure, and are the sole source of blood formation.

4. T F BUN is an accurate and early estimate of renal function.

5. T F Normal urine contains protein. A normal adult will lose as much as 100-200 milligrams per day.

6. T F The ureters connect the bladder with the kidneys and are muscular tubes.

7. T F The glomeruli are contained wholly within the cortex of the kidney.

8. T F Tachy- refers to fast.

9. T F Brady- refers to slow.

10. T F Axilla- refers to the longitudinal axis or transverse axis of an individual.

11. T F The pulmonic circulation is connected with the heart but otherwise independent of the systemic circulation for the most part.

12. T F The pulmonary artery carries arterial blood.

13. T F The cardiac output generally ranges between 4.5-7.5 Liters per minute in an adult.

14. T F The pulmonary circuit is called the "major" circulation because it is so vital to the existence of man.

PART II (continued)

15. T F Complete occlusion of a coronary artery is called "myocardial infarction".

16. T F Primary myocardial disease is a term that refers to any illness having the heart as the primary lesion.

17. T F Arrhythmias are always considered pathological.

18. T F Auscultation refers to the procedure of listening to the heart alone.

19. T F The electrocardiographic tracing is usally designated by the letters of the alphabet - P,Q,R,S,T,U.

20. T F Medical diagnosis is an exact science.

21. T F "Peristalsis" refers to a wave-like contracture occuring in the G.I. tract resulting in propulsion of food from throat to anal orifice.

22. T F Digestion begins in the mouth.

23. T F The small intestine is divided into three major segments - duodenum, jejunum and ileum.

24. T F Food passes from the stomach into the intestines continuously.

25. T F G.I. disease is developed in the military service primaril

26. T F A hernia may occur wherever there is a weakness, usually at a location where one organ must traverse thru another.

27. T F Barium is x-ray opaque.

28. T F A "sphincter" is a muscularly controlled orifice under nervous control, either autonomic or voluntary.

29. T F Foods are not absorbed from the stomach.

30. T F Bronchi divide into bronchioles, terminating in alveoli.

31. T F The deepest breath a person can take is called "vital capacity".

32. T F Breathing is controlled by the diaphragm.

33. T F One of the important hazards of smoking is emphysema.

PART II (continued)

34. T F Emphysema is a reversable process.

35. T F An important classification of exercise includes passive and assistive movement, active and resisted motion, and isometric exercise.

36. T F Muscle groups of the elbows and forearms are the flexors and extensors.

37. T F Cancer and cardiovascular disease are presently the two leading causes of death in the United States.

38. T F Mitosis is the ordered and biologically regulated process of cell division.

39. T F There are two modalities of treatment in current use in the treatment of tumors, Surgery and Radiation.

40. T F Endocrine glands secrete hormones directly into the blood stream and GI tract.

41. T F The hematopoetic system is a "closed" one, as far as cellular components go.

42. T F The circulatory system is an important one in temperature regulation.

43. T F Blood is not generally considered as one of the body tiss

44. T F A low RBC is termed leukemia.

45. T F In sickle cell anemia, the RBC's have a crescent-like shape from being exposed to too much oxygen.

46. T F Acute blood loss does not immediately manifest itself in an "anemia" because body fluids immediately replace the deficit.

47. T F Plasma makes up approximately 60% of the blood volume.

48. T F Hemoglobin is an iron containing pigment, combined with a protein component.

49. T F Blood is a conductor of electricity.

50. T F Oxygen content of blood can be measured using photoelectr techniques.

PART III. Answer each of the following using a maximum of 2 pages double-spaced.

1. Discuss some of the problems associated with the design of a modern hospital.

2. What is an electrocardiogram and what does it measure?

3. Discuss Rehabilitation.

4. Describe the work you have done to date on your project.

APPENDIX III C 1

GSFC SUMMER INSTITUTE FOR BIOMEDICAL RESEARCH IN TECHNOLOGY UTILIZATION
COMPOSITE INFORMATION SHEET

PROBLEM	TEAM & EXT.	TECH ADVISOR & EXT.	BLDG. & RM.	HOST ORGANIZATION & CODE
:rasonics :ansducers)	Johnson Biosca x.5020, 2138	Ralph Taylor x.4654	Bldg. 12 Room N226	Advanced Development Division (523)
:rasonics lectronics ;ystems)	Althouse Sirota x.5982	John Miller x.5885	Bldg. 22 Room 197 & 295A	Systems Division (Code 733)
ivity Monitor adout Systems)	Davies Armstrong x.5428	William Olden x.6133	Bldg. 12 Room E200	Advanced Development Division (521)
ivity Monitor ansducers & elemetry)	Azreal Green (x.6202 6623)	Harry Wannemacher x.6202	Bldg. 22 Room G-66	Spacecraft Technology Division (716)
ivity Monitor ectronics & ;ystems)	Hatoum Ong (x.5339)	H. Moffett Tharpe, Jr.	Bldg. 23 Room E-211	Information Processing Div. - Space Electronic Br. (Code 562)

Mr. Johnston - x.4103
Mr. Olsen - x.4103
Mr. Saunders - x.4103
Mr. Jacobs - x.6242

Note:
1. Work Orders must be submitted through Mr. Jacobs (Bldg. 8, Room 439) or Mr. Stuart (Bldg. 8, Rm. 439)
2. Tech Briefs and associated information may be acquired through Mr. Jacobs's office.

APPENDIX IVA1

Critique of

SUMMER INSTITUTE FOR BIOMEDICAL RESEARCH IN TECHNOLOGY UTILIZATION

By

Harold J. Althouse, Jr.

August 20, 1969

The first week of orientation was, in general, non-profitable: A demonstration of library operations (literature search) and a one hour talk on why we are here and what is expected would have been adequate. I was very anxious to begin the project and hence the orientation period was very long.

The school course was extremely interesting to me although not immediately applicable to my project. I felt the presentation; that is, the lecture and then trips to the respective laboratory was well planned. This was my encounter with physiology and like most novelties proved interesting. The course was well oriented toward engineering students.

Program administration was most cooperative and helpful: Funds were not made available when transducers were requested but other than this one time all requests were promptly and satisfactorily attended. Special note should be made to the technical advisors who were patient and helpful. I was very much pleased with them. The experience was invaluable.

The laboratory facilities were more than adequate. The office space supplied was appreciated and helpful. I have worked in three other laboratories and none can compare with Goddard's facilities.

Seminars were helpful in two important respects. They afforded me the opportunity to evaluate what I had accomplished to date and an opportunity to speak in public.

In closing, I want to thank all concerned for this invaluable experience and assistance.

APPENDIX IVA2

Critique of

SUMMER INSTITUTE FOR BIOMEDICAL RESEARCH IN TECHNOLOGY UTILIZATION

By

David R. Armstrong

August 20, 1969

During the course of the past five or so years, the opportunities for undergraduate engineers to obtain meaningful and educational summer employment in government agencies has steadily declined to the point that they are next to impossible to find. The primary reason for this difficulty is the displacement of Government funds to summer work poverty programs (e.g., Youth Opportunity Corps, which is intended for underprivileged Negro young people). It is for this reason that it is very gratifying to discover our colleges and universities, particularly the George Washington University, giving undergraduate engineers the chance to spend their summer working at some government lab on a research and development project sponsered by the university. Although I know this is not a common practice among universities around the country as of now, I am hopeful that it will become one as a result of this summer workshop I have been involved in this summer at Goddard Space Flight Center. At any rate, it is the beginning of a solution to the problem of providing the student engineer with an education that will prepare him, practically speaking, for the eye-opening transition from school to the "real" engineering agencies and private industry can no longer afford to waste one to two years of both theirs and the graduated engineer's time re-educating the graduated engineer to perform practically in the engineering profession.

At the beginning of this workshop at Goddard, we were divided into groups of two and each group assigned a particular project to work on. This was probably the first time any of us were given an engineering design project to complete by a given time and placed in the type of engineering environment offered at Goddard. For me it was a truly eye-opening experience. After all the theory we had drummed into our heads in college, I was really bewildered when it came to putting this theory I had learned to practical use in designing our piece of equipment. It finally dawned on me that nowhere in my school's curriculum had I been given the chance to put this theory to use to the extent this situation presented.

The experiences I have gained during this workshop will be invaluable to me when I go back to school this fall and after I graduate. Through this workshop we have been given a chance to work with state-of-the-art equipment in the labs here at Goddard and have learned much from using them. We have learned how to choose and obtain equipment and parts for our projects when the budget we were working with was tight. However, most important of all was the experience we got from designing, building and testing our project.

The cooperation and help I received from our technical advisor, Mr. William Olden, and the other engineers and technicians in my lab and others in other buildings was just tremendous and extremely helpful. I must admit I was very impressed with and thankful for their interest in what we were trying to do.

The first week of our workshop was devoted to an orientation period, most of which was a complete waste of time. Our introduction to the Biological Sciences Communications Project was so boring it even put our instructors to sleep. Next year if a program similar to this is held, the orientation period should be shortened to about one to two days at most. A complete tour of the facilities at Goddard should be given. If the students must listen to speakers, I hope the speeches are as interesting and as sincere as that given by Dr. Vaccaro, not the prefabricated speeches made by those professional tour guides that sounded as though you were listening to a tape recording, complete with a visual aid system.

Along with our projects at Goddard, our first five weeks of the workshop were partially devoted to attending a class at G.W.U. Hospital devoted to giving the engineer a knowledge of medicine. This class was disappointing and I thought it detracted from the workshop. Although it was nice to delve into the mysteries of medicine using the "systems approach", I found the course to be rather irrelevant to what we were doing at Goddard. For the projects we were working on, we did not need that much of a working knowledge of physiology. I feel that the time would have been better spent having various specialists discuss the problems they have with present equipment and how the engineering profession could help in

solving these problems. They could also demonstrate the equipment they now use and the techniques involved in making measurements on patients. I think this would have been of more interest for the students in the workshop than seeing how the kidneys remove waste products from the blood using the "systems approach". These were the only gripes I had about the workshop.

I congratulate Mr. Ken Jacobs and Dr. Vaccaro for having the foresight and drive to organize this workshop and have it turn out so well. It is a step in the right direction in broadening the scope of an engineering education.

APPENDIX IVA3

Critique of

SUMMER INSTITUTE FOR BIOMEDICAL RESEARCH IN TECHNOLOGY UTILIZATION

By

J. Marshall Azreal

August 20, 1969

The orientation to this program took much longer than it should have. I had read all the material sent to me and found some of the speeches mere repetitions of this material. A tour of the base and a project assignment session would have been sufficient orientation; and there would have been several more days to work on our projects.

It seems anomalous that our program is in anyway connected with a communications project; for there was great lack of communication between Goddard and George Washington University. GWU had said that Goddard would supply rides to those living at the University of Maryland and funds to buy the equipment necessary for parts of the program; when we got here, Goddard said this wasn't so and although these matters were straightened out, that this break-down in communication had existed certainly gave me an unfavorable impression.

EE 181 proved for the most part to be very interesting, but of little relevance to the summer's work. I now know much more about the fantastic human machine and medical test and life support equipment than I did before I took the course; however, only the lecture about the heart was of any use to me at Goddard.

I find the project assigned to me extremely interesting and instructive. I have gained much practical experience with my first exposure to integrated circuits. Much of my technical reading this summer will be of great help to me in the fall when I return to school. Although my project was to develop transducers, I was placed in a lab where no transducers were available. All electronic gear I required was available. My technical advisor has been of great help to me in designing and understanding some of the circuitry I am using. He has spent much of his time with me.

The only indication of a link between this program and the Biological Sciences Communication Project would be the seminars. Seminar type sessions should have been held throughout the summer so that everyone in the program would know what everybody else was doing. In that way, we may have been of more help to one another in our literature

searches as well as in sharing circuitry we developed in the laboratory. It was nice to know that somebody was interested in the work that we were doing, as the audience indicated.

One of the worthwhile features of orientation that is worth special note was the talk on the library facilities.

APPENDIX IVA4

Critique of

SUMMER INSTITUTE FOR BIOMEDICAL RESEARCH IN TECHNOLOGY UTILIZATION

By

Louis Biosca

August 20, 1969

1. Orientation - for the most part a waste of time. It could have been cut down to a brief "welcome aboard", a project discussion, and our own project and lab orientation. Also the librarian's talk should be included.

2. Course - well presented and well slanted toward the engineers point of view.

3. Personnel - exceptional in their cooperation and the use of their time. No one hesitated to help me find needed equipment, discuss my problems, and suggest new approaches to problem areas.

4. Working Conditions - truly great when one considers technical help available, test equipment and components all at our disposal.

5. Seminars - basically a waste of my time since 50% of the time spent at them were "BS" sessions. The concept is good until we let someone - anyone- moderate it. Two engineers can get more accomplished in less time talking face to face then they will ever be able to do with a moderator.

6. Overall - feel that this was one of the best spent summers as far as practical working experience is concerned. If nothing else, I am now familiar with test equipment available within a lab and its use. The experience was well worth it and is highly recommended by me.

APPENDIX IVA5

Critique of

SUMMER INSTITUTE FOR BIOMEDICAL RESEARCH IN TECHNOLOGY UTILIZATION

By

John Clay Davies III

August 21, 1969

In this report I will try to review the experiences of my summer here at Goddard Space Flight Center. This paper is a necessary one since certain criticisms must be made to insure a successful program in the future. Five concentrations will be covered: orientation, course work, personnel, work situation and the seminars.

An orientation is a necessary part of any successful program. However, I feel the orientation given to us was repetitious and sometimes quite boring. The best way to explain this is to explain what orientation should have been. First, the literature mailed to us was very informative and answered many of our questions. This should be continued in the future. The opening comments by Mr. Ken Jacobs and Dr. Michael Vaccaro were interesting and pertinent. All other comments and films were redundant and should have been dropped with the possible exception of the librarian's talk on Goddard's Library System. This could all have been accomplished in the first meeting. That afternoon could have been spent on the assignment of project, and work could have been started the next day.

The field trip to Biological Science Communications Project was not useful at all. It seemed as if the personnel there were just trying to fill the time alloted to them.

In short, orientation should include a short welcome to Goddard, explanation of facilities available to us, and finally the explanation of the projects and what is expected of us.

The course in Medical Engineering given at this Summer Institute had nothing whatsoever to do with the project being worked upon. The time spent on this course could have been better spent on the projects. The lectures were mostly boring and provided nap periods for most of the students. I think the course is unnecessary and should be left out completely.

The personnel here at NASA-Goddard have been wonderful. Whenever questions needed to be answered, not only would our technical advisor offer his help, but many others would drop by to give us a hand. The personnel could not have been better.

Excellent lab facilities were provided for us to do our work. Any equipment was gladly given to us if available.

I feel that the work period was interrupted too many times for silly meetings and conferences that were held just for the sake of having them. The information, if any, obtained in these meetings could have been given to us individually. One got tired of the same talk each week.

I would like to see a well-established pay period. Many times I have depended on my check to come and it would not be there. This should be corrected.

The Seminar is a good idea. It gives an opportunity to the student to present the work that he has done. I do feel, though, that the first seminar we had was a little drawn out.

In summary, the Institute is an excellent idea. I have never learned so much about engineering before. I feel a program such as this should be included in every engineer's curriculum. I do feel, however, that much time was wasted in mickey mouse activities and by individuals trying to build their egos and prestige.

APPENDIX IVA6

Critique of

SUMMER INSTITUTE FOR BIOMEDICAL RESEARCH IN TECHNOLOGY UTILIZATION

By

Jeffrey Green

August 20, 1969

My interpretation of the success or failure of the Summer Institute in Biomedical Research falls into two categories, the first of which is mechanical.

The majority of the time (at least the first six weeks) was accompanied by uncertainty involving mechanical procedures. Classes seldom if ever met punctually. A small portion of the lecture series, if not boring, seemed totally irrelevant to the projects to which we were assigned while the projects themselves were at first very vaguely defined.

The week of orientation, whose purpose I think, was to define the purpose of the Institute, could have possibly been reduced to two days of precise briefing. The tours themselves were very interesting, most the the talks enlightening, but in the light of an objective to be accomplished in a short ten week period, they become secondary and unnecessary.

The information given us concerning the use of NASA literature proved to be extremely helpful, the technical advisors assisted greatly in the development of the project, and the employees of NASA themselves, if not overly interested, aided whenever possible.

In retrospect, mechanical procedures of the Institute over an eight week period, though somewhat unstable, were none the less expected and because it was the first such program of its kind, small irregularities in administration are easily overlooked.

Introspectively speaking, however, the "success" or "failure" of the Institute assumes greater proportions and becomes solely a matter of interpretation. In an effort not to be misunderstood, I say that its conceptual value to me is unquestionable. I learned much about engineering in its broadest sense. By working with students with three years of academic performance behind them, I greatly added to my own one year. Still, the question of success or failure is

to be answered. If the expectation of the Summer Institute was to instill, in a ten week period, a flaming desire for the profession of Biomedical engineering, then in my case, it failed miserably. If its purpose was to produce workable, manufacturable hardware over this time, then it was partly successful. But if its purpose included teaching a group of engineers-to-be something about engineering, its success was overwhelming.

APPENDIX IVA7

Critique of

SUMMER INSTITUTE FOR BIOMEDICAL RESEARCH IN TECHNOLOGY UTILIZATION

By

Mohammed H. Hatoum

August 20, 1969

1. The orientation lectures were good because they introduced the student to the atmosphere at Goddard, although they could be a little more comprehensive.

2. The hospital course was very informative and helped in introducing the student to many important concepts in medicine. The course should probably be extended to a period of ten weeks instead of just five.

3. In choosing working areas, more attention should be paid to the problem of locating the student in a laboratory which is as closely as possible oriented and equipped with the needs of the project. In my case mislocation in the wrong lab caused me a waste of two weeks in the beginning of the program.

4. The personnel at Goddard are just marvelous people. I myself received help and cooperation from my advisors as well as anyone I ever asked for assistance or advice.

5. The program itself is a very good concept. Generally, it was conducted in a good manner, although some financial problems were sometimes present as far as funds to buy equipment and materials needed for the project.

NASA ought to be congratulated for such a great idea as having students straight from the classroom transferred to real-life laboratories, working on creative projects. NASA also could be proud of the fact that some of the student's work results are patentable and publishable, as well as ready to operate.

APPENDIX IVA8

Critique of

SUMMER INSTITUTE FOR BIOMEDICAL RESEARCH IN TECHNOLOGY UTILIZATION

By

Vivic Johnson

August 20, 1969

The objectives of the Biomedical Engineering project were laudable if they could be achieved in 10 weeks. This was my first impression of the Summer Institute.

The period of orientation was long, drawn out and became boring at the end. This could have been conceivably covered in 2 days with the visit to BSCP omitted.

The course, "Introduction to Medical Engineering", was stimulating in parts. Several lecturers were outstanding in knowledge of subject matter and presentation, but did not give any correlation between the fields of engineering and medicine. A lot of insight was gained on an overall basis into the problems of the physician. Other lecturers were uninspiring, did not seem to know how or what to present to a group of engineering students. The major comment on the course was that it was not relevant to the project to be researched as was hoped for.

As a first attempt the administration of the institute was understandably not as smooth as it could be. The most glaring inconsistency was to be informed in the middle of the period that the grades for the course were dependent on the results of the research project. This is a course regularly scheduled at George Washington University offered to students, and carrying 3 credit hours.

The projects seem to lack control and direction for the first weeks, especially the ultrasonic beams. Understandably, the students had many ideas of improving the state of the art, but this should have been headed off from the first few weeks. It was impossible to research and develop many of these ideas in 10 weeks. It seemed that a lot of talking was being done and no action. As was eventually brought out most of those innovating ideas had to be discarded after so many weeks wasted in discussion.

The Goddard personnel was very cooperative in areas of aid in getting equipment, but did not understand too readily the intricacies of the problem with which we were faced. Most of the time was spent just trying to understand the use of the test equipment. This used up valuable time which could hardly be spared in a 10 week program.

The seminars went quite smoothly, although none (of the) top level administration personnel (that) were expected (attended). The presentations were very impressive and showed that a lot had been accomplished in the past weeks.

Notwithstanding, this has been a very meaningful experience for me. I have gained invaluable knowledge into the working conditions of a graduate engineer fresh out of school, the problems he is faced with, and the way in which he should proceed toward a solution. My meager knowledge of sophisticated electronic test equipment has been immeasurably enhanced. The interaction of engineers and administration and the problems involved have been pointed up.

This program on a whole should in my opinion be continued. With a firmer definition of goals to be obtained, and some ironing out of administrative problems, this summer program should become very productive and educative.

APPENDIX IVA9

Critique of

SUMMER INSTITUTE FOR BIOMEDICAL RESEARCH IN TECHNOLOGY UTILIZATION

By

Philip Ong

August 21, 1969

First Week Orientation.

It is very important to have the introduction to "who's who" in the program. I have enjoyed every phase of the introduction to NASA - especially the tour - which I have found to be a very informative and educational part of the program.

I also found it very exhaustive in attending introductory speeches one after another. It can certainly be improved if some of the speeches can be eliminated - especially those that are repetitive.

The Course.

The course is very educational and invaluable to an individual's general knowledge of the medical field and anatomy. It helps tremendously the groups working on transducers - although not so much in the electronics and systems areas.

Personally, I do not like the idea of grading students, an examination for the course, and being given credit for it. This is essentially a course given to aid the individual in his work, and should be used for that purpose only.

All in all, I have enjoyed the course and loved most of the lectures.

Administration of the Program.

The administration of the program could be improved by:

1) Making sure of the financial part of the contract is adequate to accomplish the project successfully without hindrance.

2) Knowing the problems of the project way before hand and finding technical advisors knowledgeable in that field and assigning the students to them accordingly.

3) Making sure that the environment in which the students are working in is suitable before hand instead of wasting time shuffling them from one place to another.

4) Being sure that students can contact someone - anyone, at all times so that time would not be spent on trivial questions and problems - also the students would be put on the correct track before too much time is spent on the wrong ones.

Working Conditions.

Our technical advisor was a very helpful one and has given us invaluable aid. The labs are adequate enough (after some shuffling in my case) although it could be better. For example, my partner and I have found another building working on exactly the same integrated circuits as ours and we would have been in a more suitable working environment had we been located there.

On the whole, the labs are adequate and other NASA personnel in our section have shown some interest in our work and have aided us.

Seminar.

Personally, I think that the seminar we had is too long. This is mainly due to the students going into minor technical details which in my opinion is unnecessary. I suggest that each student follow the following form:

1) Explain the problem and/or criteria.

2) Explain briefly what he has achieved up to date.

3) Explain what problems he is facing and how he intends to solve them.

To sum it all, I have enjoyed myself tremendously, gained invaluable experience, and hope that what I have accomplished will be of some satisfaction and/or return to all involved.

APPENDIX IVA10

Critique of

SUMMER INSTITUTE FOR BIOMEDICAL RESEARCH IN TECHNOLOGY UTILIZATION

By

Leonard B. Sirota

August 20, 1969

For a college senior this summer's program has been an invaluable experience in engineering application. The facilities available at Goddard along with the engineering personnel make this an ideal location for such a program. With only a few exceptions the administration has done a fine job planning and carrying out this project.

The program started with an excessively length orientation which contained valuable information about the resources available for our use but, these points were overshadowed by the useless, time consuming activities such as the day-long trip to the B.S.C.P. headquarters and the redundant speeches given by the administration. If orientation had been shortened to two days and the emphasis had been placed on such items as what departments were located where at Goddard and what funds were available to us then, I believe that it would have been more successful. An example of this type of orientation would be listing the specialties of men like Ralph Taylor who supplied useful information about transducers. This could be presented in a manner similar to that of the introduction to the library, giving names of key people in the fields relating to our projects.

Engineering Introduction to Medicine, the course taken inconjunction with our program, was well presented. The concept of having specialists lecturing in the different phases of medicine assured us of an up to date presentation of the theories involved. My only criticism is that the instructors lost their perspective of the objectives of the course or, at least they did not convey it to the students. This was demonstrated by the final examination which seemingly had little to do with the lectures or the readings. The most informative part of the course was the briefing and demonstration of the technology now being utilized in medicine and attitude of the doctors toward mechanization.

Electronics for the ultrasonic motion detector was the project which I was assigned to. My laboratory was well equipped for this work, containing nearly every instrument needed for this job. Our technical advisors were knowledgeable in almost all phases of the circuitry necessary for the

task and were quite willing to spend time helping us. Without their assistance and the advice of the others in our laboratory progress would have been much slower. We encountered only minor problems in acquiring materials, since most essential items were either available at Goddard or easily obtained as samples from manufacturers. Therefore, if our project is not entirely completed by the end of our ten week period the blame cannot lie in any of these regions.

It is my opinion that our project was greater than what could reasonably be completed in our stay here. Our goals were not clearly enough defined in the early stages of our work and added to the delay in the results. The group discussions (with all ten members of the program) proved of little value as far as assisting our project. The first seminar was designed not only as a time for progress reports but, at a time for constructive criticism and suggestions. This came too late in the program to be of use to us and when we finally did have it we only gave reports and gained no more than the experience of doing such.

Looking at this summer from a broad perspective, I have thoroughly enjoyed the work. I found my particular project interesting as well as challenging. My only regret is that I will probably not be able to see it through to a satisfactory completion due to insufficient time.

3. THE COURSE

What are your comments on the time allocation during the class period (lecture, questions, break, project discussion, etc.)?

_____

_____

What were your impressions of the text? _____

_____

The pamphlet? _____

_____

The examination? _____

_____

Would you have attended the Summer Institute if the course had not been for credit? _____

4. THE RESEARCH PROJECT

Do you think you spent sufficient time reviewing the literature prior to beginning your project? _____

Are you satisfied that you contributed to solution of a bio-medical problem? _____

5. THE FUTURE

Do you expect to discuss your participation in the Institute with fellow students upon your return to school? _____

Do you expect to discuss the NASA Technology Utilization Program with fellow students upon your return to school? _____

Would you recommend this program to interested fellow students (Juniors) if it were to be held next year? _____

With what were you most impressed at Goddard? _____

_____

_____

Would you like to work at Goddard after graduation? _____

Do you plan to continue study and research in the area of medical engineering? _____

What are five specific improvements you would recommend on the Institute?

1. _____
2. _____
3. _____
4. _____
5. _____

Any other comments not mentioned above or in your Critical Review:

_____

_____

_____

_____

_____

Thank you.

SUMMER INSTITUTE FOR BIOMEDICAL RESEARCH IN TECHNOLOGY UTILIZATION COMMENTS AND RECOMMENDATIONS

Kenneth F. Jacobs - October 1969

This program, I feel, was a remarkable success. It should be kept in mind that it was conducted under adverse conditions, i.e., we started very late; we had no precedent to guide us in such a program; there were too many parties involved in the contractual arrangements---although it is acknowledged that the Institute could not have happened otherwise. I must say that, nothwithstanding the efforts of all those individuals at GSFC and GWU who labored to make this program the success it was, a great deal of the credit should go to the students themselves who showed that what they really wanted was a chance to prove themselves worthy of vesting in them the responsibility of a meaningful research effort. The manner in which they conducted themselves bespeaks of the success of this program. The ten weeks were too short to expect the kind of results achieved. They went through almost a week of orientation, a three-credit graduate level course, had to familiarize themselves with sophisticated equipment they had not seen before, had no monies available for special pieces of equipment but rather had to make their own contacts and plead their own case for the materials they required, were presented with engineering problems they were never expected to completely solve, and nontheless presented prototype hardware which, admittedly needs refinement, but has answered a host of difficult engineering questions that the GW University staff estimated would have cost approximately $250,000 to achieve otherwise. The students' enthusiasm prompted them to request of me a clearance for them to work three hours overtime during the last week of the Institute. I believe that the program has succeeded in attaining all of its objectives.

I strongly recommend that this kind of a summer program be conducted at each of the NASA Field Centers, and an effort toward the solution of engineering problems of clinical medicine be made, as opposed to research type

problems. Solutions in the clinical area are more desirable since the transfer of the results can be realized much more rapidly, and get to the people much more quickly than can solving problems in the area of basic reasearch.

It is further recommended that the effort conducted at GSFC not be abandoned by NASA. The Technology Utilization Division should strongly consider funding a follow-on effort to bring the prototype hardware through the production model stage, to assure the transfer of the technology and expertise which so strongly supported the development of the prototypes. This would include the Activity and Environment Monitor system, and the Ultrasonic Motion Detector. The George Washington staff has indicated their intense interest in such an action.

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA GEN. REG. NO. 27
9010-106

UNITED STATES GOVERNMENT · APPENDIX IV A 13

Memorandum

TO : Mr. Kenneth F. Jacobs
Special Programs Office, A&MD

DATE: September 24, 1969

FROM : Mr. Ralph E. Taylor
RF Support Office

SUBJECT: Comments on Summer Institute for Biomedical Research in Technology Utilization (TU)

Two student researchers (Messrs. Louis Biosca and Vivic Johnson) were assigned to the RF Systems Branch, Code 523, under the subject TU Program.

This assignment resulted in an excellent cross-fertilization of two scientific disciplines - electronic engineering and biomedical research. The availability of all types of high-quality electronic test equipment, in our laboratory, proved to be an immediate advantage to the students. Also, the availability of "quick-reaction" type machine-shop fabrication facilities considerably enhanced the students' progress in the hardware area.

The two assigned students conducted research on an Ultrasonic Motion Detection System for arterial-wall motion measurements. Specifically, they investigated transducer-detection phenomena; they were successful in improving a medical instrument by developing electronic circuitry to remove one of the two transducer elements, thereby reducing production costs without significant performance degradation.

In brief, it was a very worthwhile effort and we appreciate the opportunity of participating in the program.

Ralph E. Taylor
RF Support Office
RF Systems Branch
Advanced Development Division
Tracking & Data Systems Directorate

cc: Dr. R. J. Coates, Code 520

523:RET:mjb

CRITIQUE OF THE SUMMER INSTITUTE FOR BIOMEDICAL RESEARCH IN TECHNOLOGY UTILIZATION

It was my pleasure, this summer, to be associated with Mr. Philip Ong and Mr. Mohammed Hatoum of the George Washington University. Messrs. Ong and Mohammed were responsible for development of the electronics system for a physiological and environment monitor.

It is my feeling that this summer institute has been extremely valuable to Mr. Ong and Mr. Mohammed in that it allowed them to gain first-hand experience in a working environment. This, you do not receive in a university atmosphere even when in the university laboratory conducting experiments. These two gentlemen very quickly realized that problem solving in an engineering environment does not always go by the "book". Much of the task involves determining exactly what the problem is. To receive engineering experience as well as to produce a much needed end product is ideal, and this is exactly what happened in the summer institute.

I would like to cast my vote for continuing this program and say that I wish it had been available when I was an undergraduate in engineering school.

H. Moffette Tharpe, Jr.
Space Electronics Branch

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MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

TO : Mr. Kenneth F. Jacobs, Code 207
Special Programs Office

DATE: September 25, 1969

FROM : John E. Miller, Code 733
Applications Experiments Branch

SUBJECT: Comments on the Summer Institute for Biomedical Research in Technology Utilization

As requested, the following comments are offered concerning the Summer Institute for Biomedical Research in Technology Utilization.

The objective of the team for which I served as an advisor was to develop a working model of an ultrasonic stethoscope using low cost components. A further objective was to miniaturize the unit such that it could be used in a manner similar to the conventional stethoscope. This work was to be accomplished by a team of two senior engineering students in a ten week period on virtually a part-time basis.

It is my opinion that the above objectives were very ambitious and somewhat unrealistic relative to the level of staffing and training of the personnel. A more realistic level of effort would be one to two man-years rather than the four man-months allocated.

The people who I advised, Mr. Althouse and Mr. Sirota, were highly motivated and extremely interested in the detailed theory of each circuit on which they worked. As a result, the time spent on learning and applying the theory was at the expense of meeting the objectives. It should not be construed however that the time was wasted. To the contrary, the students gained valuable experience and insight into the real-life world of engineering.

Based on my experience as an advisor and a knowledge of the objectives of the program, I would like to offer the following recommendations. First, the results of the program could be significantly improved if the senior engineering student teams were augmented by an engineering graduate student. The graduate student would serve as a full-time contributing member of the team and would also be an advisor for the more routine problems. This in turn would result in more progress and allow the advisor to spend his limited time on the more difficult problems.

9010-106

Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan

Subject: Comments on the Summer Institute for Biomedical Research in Technology Utilization

Secondly, any meaningful project is going to require more time than is available through the Summer Institute. For this reason some provision should be made with the cooperating universities to insure the continuity of the project through to a successful completion. Under this arrangement more time could be spent during the Summer Institute in the research, development and planning of the project. In essence the end result of the Summer Institue would be a proposal outlining both preferred and optional approaches, the applicable technology and experimental results obtained from breadboarded circuits or computer simulations. This effort should then provide a firm base on which to establish the project at the university.

In conclusion, let me say that I found the experience both rewarding and challenging and look forward to participating in the program again.

John E. Miller
Applications Experiments Branch

JEM:lac

COMMENTS ON SUMMER INSTITUTE

1) Money for unusual parts was never found. We found if it could not be obtained without cost, we could not obtain any par
parts. What happened to this money?

2) Waste of time for most lectures, meetings, etc. Long winded chiefs wasted indians time.

3) Several students complained that the advisors were not capable of answering questions to the students level. Advisors should be more carefully screened.

4) Our section of the project worked, the students learned enough to justify the effort and it was interesting.

Wm Alden
Code 521